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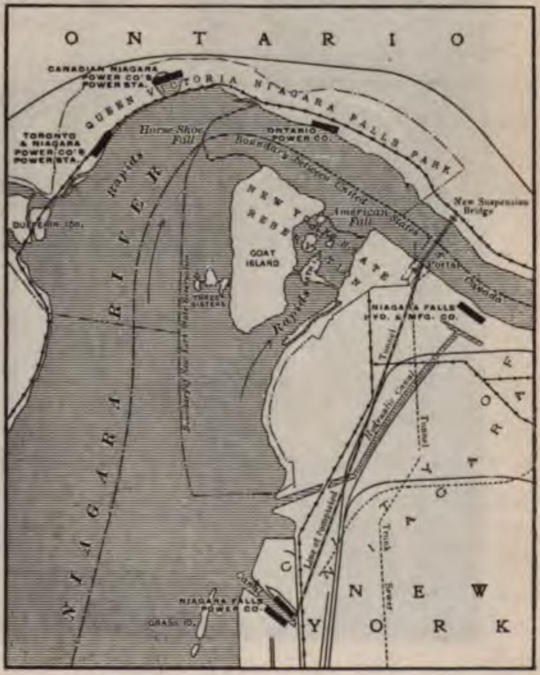
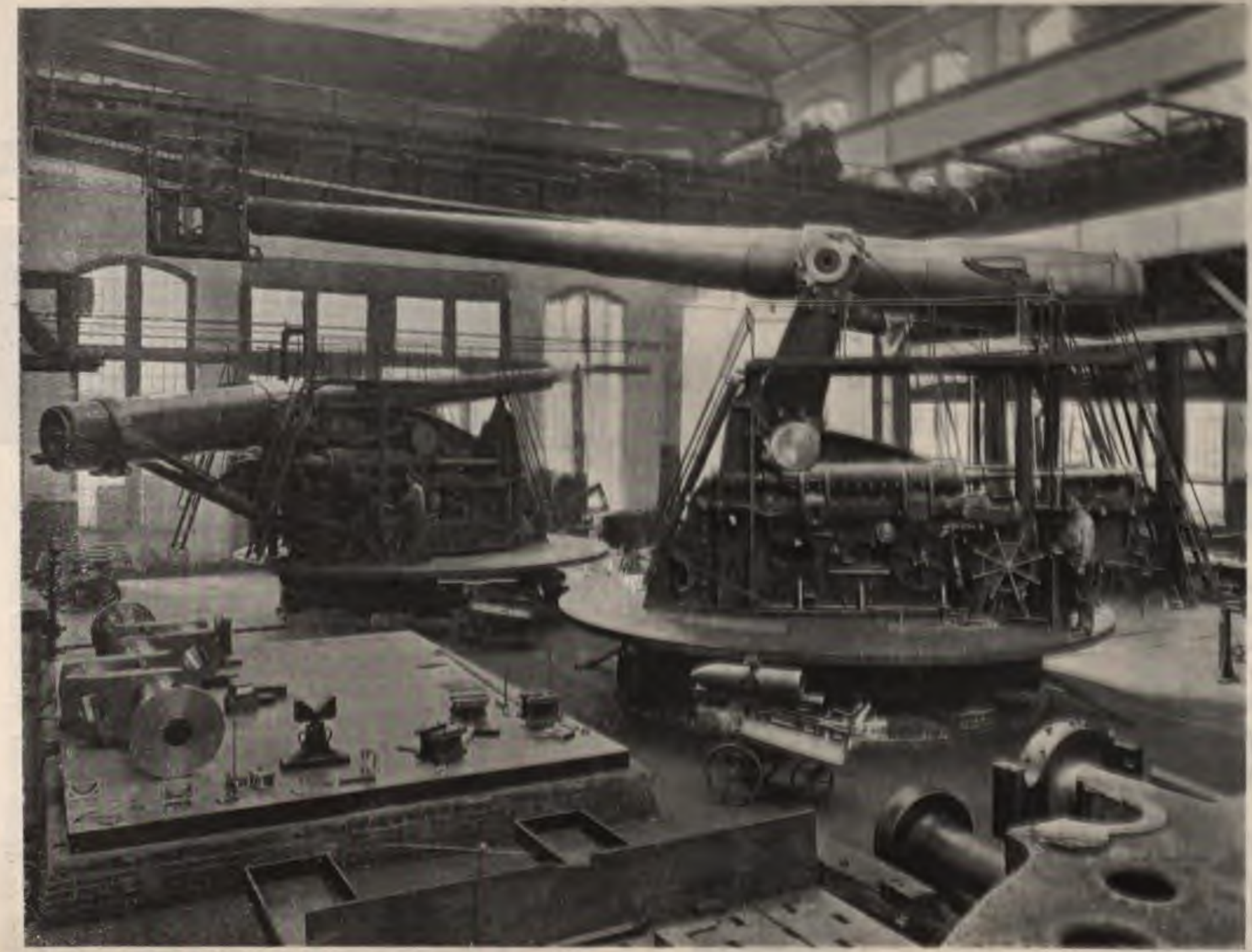
IN previous notes I have commented upon the heat-value of a pound of coal when burnt to the fullest advantage. A few practical hints as to the best means of accomplishing this, follow in natural sequence. But, first of all, I have to thank a correspondent for kindly drawing attention to an obvious omission of mine, for which I cannot even plead the excuse that it was Christmas-time. On page 903 I neglected to specify that the work done in raising 33,000 pounds through one foot, or in the heating of one pound of water through 42·7 degrees Fahrenheit of temperature, in order to equal one horse-power, must be performed in *one minute*, the time being, of course, an essential element in a statement of this kind.

Now, as to the best type of boiler for the economical production of steam. It may pretty well be taken for granted that all surviving well-known types of boilers are capable each in its own way, and for its own purpose, of effective steam-raising if properly handled. Of these the principal in general use are the Lancashire or double-flued cylindrical boiler; the Cornish or single-flued boiler; the water-tube boiler, in various forms; the loco-type boiler, and the internally-fired, return-tube boiler. The smaller kinds of vertical boiler, and small boilers of any kind, as a rule, are installed with other objects than fuel economy, and call for no notice here. Externally-fired cylindrical boilers of all kinds are also out of the running on account of the inevitable deposit of scale on the bottom of the boiler, just where it is exposed to the greatest heat.

The points to be borne in mind in regard to the effective combustion of fuel — proper



MAP OF NIAGARA FALLS, SHOWING LOCATION OF THE VARIOUS POWER STATIONS.



TWO OF SEVEN 12-IN. BREECH-LOADING RIFLES AND DISAPPEARING GUN CARRIAGES BY THE MIDVALE STEEL COMPANY, PHILADELPHIA, PA. (*See page* 10.)

management of the fire being assumed—are, the furnace should be spacious in proportion to the firegrate area, height above grate being an important advantage. Thus, a long grate in a circular flue of small diameter is not desirable. Actual combustion of the generated gases can only be secured by having the heating surfaces (which, so far as the fire is concerned, are cooling surfaces) at a sufficient distance from the fire to avoid extinguishing the flame and chilling down the gases by premature contact with the sides or top of the furnace. Unconsumed gases have a tendency to remain in contact with the plates, and thus, besides representing an actual loss in themselves, effectively cut off the radiated heat of the burning fuel, owing to their non-conducting properties.

Theory and successful practice unite in proclaiming that a high and continuously maintained furnace temperature is essential to proper combustion. No one who has enjoyed the opportunity of watching the firing upon an express locomotive engine during a long run can have failed to notice the extraordinary efficiency of pure radiant heat. For many miles, before the conclusion of the run, the stoker has ceased to ply the furnace with coals. The fire, urged by the tremendous blast, becomes a glowing white-hot mass, and burns down thinner and thinner, the engine, meanwhile, steaming with the utmost freedom. Mile after mile this goes on, until the lights of the terminal station are in sight, and the engine brings up its heavy train with barely as much incandescent fuel in the fire-box as suffices to cover the bars. Under these conditions evidently the furnace temperature is at its highest, and that of the chimney at its lowest; hence the ideal state of working through the maximum range of temperature is approached—for a time.

The nearest permanent approach to this would be the burning of the fuel in a separate furnace or combustion-chambers with walls lined with firebrick, and of sufficient thickness to prevent the sensible loss of heat by external radiation. The glowing walls and roof of the furnace reflect upon the burning fuel its own intense heat and the condition of completed combustion before the heat is abstracted from the gases would be nearly realised. A short flue with two or three baffle-walls to break up and mix the gases would connect the furnace with the boiler; and there should be a rapid draught through and amongst the burning fuel, preferably admitted by a series of small distributed openings. Not one boiler in ten thousand is fitted with this adjunct, but an approximate effect is obtained in many cases by the spacious furnaces used in connection with some water-tube boilers. Locomotive fire-boxes also, when fitted with the fire-brick arch and ventilated fire-door with deflecting plate, and skilfully fired, are efficient furnaces at certain rates of combustion.

In ordinary firing with any class of boiler, the air is for the most part admitted to the furnace through the air-spaces between the fire-bars. The layer of coal should be of uniform thickness and not too thick, and the clinker should not be allowed to obstruct the air-spaces. The fire should be fed at short intervals with correspondingly small quantities of coal, instead of allowing it to burn down low before throwing on a large quantity, thus lowering the furnace temperature by the abstraction of the heat required to gasify the volatile constituents of the new supply. The lowering of the temperature leads to a reduction of the chimney draught at the exact time when the highest temperature and the greatest admission of air are required to effect the combustion of the hydrogen, which, as a consequence, passes away unconsumed, having added nothing to the useful heat of the furnace. A portion of the carbon, also, which at the moment of throwing on fresh coal was floating about in the furnace at a high temperature in search of oxygen to combine with, is cooled down below the temperature necessary to its combustion, and passes wasted away into the atmosphere either in the form of smoke or combined with the hydrogen as olefiant gas, a valuable compound of six parts by weight of carbon to one of hydrogen. A few minutes' observation of almost any boiler chimney will show by the dense cloud of black smoke emitted at intervals that the intermittent system of firing with the consequences just described is in full force. It is well worth the while of any owner or user of a steam boiler to look carefully into the question, and if the abuse exists to seek the remedy.

The great power scheme of the Toronto and Niagara Power Company, a description of which is completed on page 21, is only, of course, one section of the work involved in harnessing Niagara. The operations which are at present in progress along the Niagara frontier are ably summed up in the Electrical World and Engineer of New York. It is shown that plans are now under way for the development of more than 1,000,000 electrical h.p. with water between the Lake Erie and Lake Ontario levels. Of this total development 146,600 h.p. is represented by the present capacity of hydro-electric plants that are already in operation. Plants now under construction and at various stages of completion have been designed for an ultimate capacity of not less than 553,500 electrical h.p., and plants for which franchises have been secured and real estate purchased, but on which actual construction work has not been started, will, it is said, add not less than 360,000 h.p. to these figures. Of the five plants now in operation, three are in the city of Niagara Falls on the American side of the river, one is in Queen Victoria Park, Niagara Falls, Ont., and another is at the foot of the Niagara escarpment, about three miles from St. Catharines, in the same province.

The two best known plants are those of the Niagara Falls Power Company, on the American bank of the river, which have a combined capacity of 105,000 h.p. Farther down stream, on the same side and also within the city limits, is the station of the Niagara Falls Hydraulic Power and Manufacturing Company, with a capacity of 30,000 h.p. in the electric generators there installed. Just across the river, in the park on the Canadian bank, is the water-driven plant of the International Railway Company, with a generator capacity of 3,600 h.p., including the machine that is just going into position. The station of the Hamilton Cataract Power, Light and Traction Company, near St. Catharines, has a present operating capacity of 8,000 electrical h.p., which brings the total rating of generators at the five stations between the Erie and Ontario Lake levels up to 146,600 h.p., as above noted.

Turning to plants now under construction, the Canadian bank of the river, from a point just below the Horseshoe Falls to more than a mile upstream, is the scene of greatest activity. Along this stretch of park are ranged the partly completed plants of the Ontario Power Company, the Canadian Niagara Power Company, and the Toronto and Niagara Power Company. The plans of these companies in the order named call for ultimate developments of not less than 180,000, 110,000 and 137,500 h.p. respectively. Near these three great plants is that already mentioned of the International Railway Company, where provision has been made for the installation of additional units, aggregating 6,000 h.p., as soon as they are wanted. At the plant above mentioned, near St. Catharines, an extension is under way that will add 40,000 h.p. to its present capacity. Less new work is in progress on the American side of the falls, but the Niagara Falls Hydraulic Power and Manufacturing Company has started excavations for a new station of 80,000 h.p. capacity there. The six plants just mentioned as in progress of construction foot up the total of 553,500 h.p. above named. It thus seems that the capacities of electric generators now operating with water from Lake Erie, plus the capacities of the machines required to complete the plants in progress of construction, amount to no less than 700,100 h.p.

THE UNITED STATES CRUISER "COLORADO."

NEWS ITEMS.

The U.S. Cruiser "Colorado."

It is anticipated that the new United States armoured cruiser squadron will not be ready for commission before July, 1905. The squadron will consist of the cruisers *Colorado*, *Maryland*, *Virginia*, and *West Virginia*.

The latest quarterly issue of the American Society Naval Engineers, to hand yesterday, has *inter alia*, an account of the United States armoured cruiser *Colorado*, by Lieut. Commander E. H. Scribner, U.S.N.

The *Colorado* is one of the six vessels of this class authorized by Congress in 1900; she was launched April 25th, 1903. The dock trial was held June 21st, 1904, and the contractor's trial took place off Delaware Breakwater (June 30th to July 3rd, 1904), July 2nd, 1904, over a measured course 1½ knots long.

The main battery consists of four 8-in. B.L.R.'s, 45 calibres in length; fourteen 6-in. R.F. guns, 50 calibres in length; and eighteen 3-in. R.F. guns, 30 calibres in length. The Secondary Battery has twelve 3-pounders, semi-automatic; four one-pounders, heavy, semi-automatic; four one-pounders, heavy, R.F. guns; two 3-in. field guns; four machine guns, 30 calibre, and six automatic guns, 30 calibre. Two 18-in. submerged torpedo tubes are to be installed.

The protection of the vessel consists of a complete armour belt, 7½ ft. wide, 6 in. thick for a distance of 4 ft. from the top, below which it tapers to 5 in. in thickness at the bottom.

The main engines are four-cylinder, triple-expansion, vertical, inverted-cylinder, direct-acting, placed abreast in watertight compartments and separated by a middle-line bulkhead. The engine design provides for outboard turning screws when going ahead. The order of the cylinders, beginning forward, is high pressure, intermediate pressure, forward low pressure and after low pressure. The H.P. and I.P. cranks are opposite, also the forward and after L.P. cranks, the second pair being at right angles with the first. The sequence of cranks is H.P., forward L.P., I.P., and after L.P. The framing of the engines consists of forged-steel columns trussed by forged-steel stays for the outboard side, and cast-steel housings of inverted Y shape for the inboard side, the latter carrying the crosshead guides of *cast iron*, slipper type, made hollow for cooling water. Each cylinder has one cast-steel inverted Y-frame housing (cast in two halves and bolted together) and two hollow forged-steel columns for its supports. The engines are tied to each other by athwartship braces at H.P. cylinders and after L.P cylinders.

The boilers are thirty-two in number, placed in six watertight compartments, three compartments on each side of the middle-line bulkhead.

The speed trial took place over the Cape Ann course, 44 knots long, on October 24, 1904. The sea was smooth and weather conditions good. The machinery worked very satisfactorily indeed; there were no hot bearings, and the boilers made all the steam the engines could use under the conditions imposed by the navy department, limiting the steam pressure in the H.P. receiver to 250 lb. per square inch.

The average speed during the entire run, corrected for tide, was 22·224 knots.

Mersey Dock Improvements.

The Mersey Docks and Harbour Board are spending £41,000 in deepening to 19 ft. 6 in. below the old dock sill the greater part of the body of the Queen's Dock, with the view of bringing the branch dock into effective use.

German Machinery Exports.

The remarkable development of the German machinery trade and industry in recent times is shown by the fact that during the past decade the total value of machinery of all descriptions, including locomotive and other steam engines, as well as sewing machines, exported from Germany, has increased very nearly threefold. In 1894 the total exports amounted to £3,970,000; their value in 1903 rose to £11,600,000. The rate of increase in the exports during the last three years has not been quite so rapid as during the preceding seven, but even in these three years the total value of the exports increased from £10,035,000 in 1901 to £11,600,000 in the past year.

Germany as a Customer.

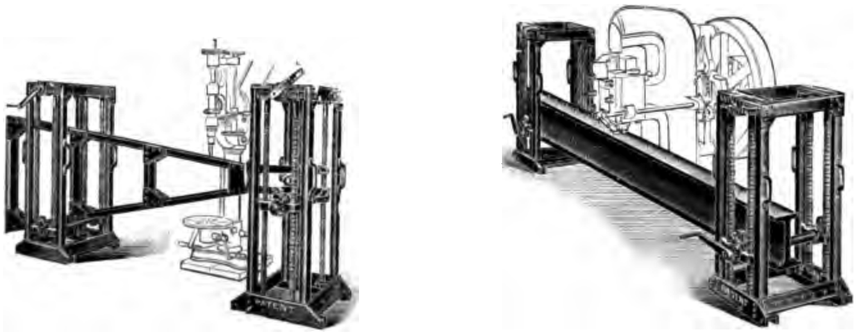
The imports of all kinds of machinery into Germany during the past ten years has increased from £1,415,000 in 1894 to £2,855,000 in 1903, or about a quarter of the exports. The statistics show that a comparatively large falling-off during the last three years has taken place in the total annual value of the imports of agricultural, electrical, and cotton-spinning machinery, but an increase in machine tools, pumping machinery, steam engines, locomotives, and sewing machines. Agricultural machinery was imported chiefly from the United States, the United Kingdom, and Canada; electrical machinery chiefly from Switzerland. Cotton spinning and weaving machinery has at all times been imported almost exclusively from the United Kingdom; machine tools from the United States, milling machinery chiefly from Switzerland; brewing and distilling machinery chiefly from the United Kingdom; pumping and lifting machinery chiefly from the United States; rolling machinery, ventilators, machinery for cutting metals as well as for working wool, were all imported chiefly from the United Kingdom; machinery for manufacturing wood pulp and paper chiefly from Belgium; steam engines and steam boilers from the United Kingdom and from Switzerland; locomotive engines and locomobiles chiefly from France and from the United Kingdom; sewing machines from the United Kingdom and from the United States. These interesting facts are from a report by Sir William Ward, British Consul-General in Hamburg.

A Portable Conveyor.

In the accompanying illustrations, a useful form of portable lifting and conveying apparatus is shown at work. It is a handy form of appliance for the workshop and erecting shop, but is more particularly designed for handling girders, joists, heavy shafts, rails, long pipes, beams, etc. The lifting and lowering is effected by means of the handle on the top wormshaft and the vertical spindles are in pairs, screwed right and left hand thread, to ensure the load being raised or lowered in a uniform manner.

The load can be stopped at any point. It rests on a roller which is turned by a handle, thus giving a traversing movement either to the right or left as desired.

In the illustrations the apparatus is shown as an auxiliary to machine tools. When intended for use on a level floor it is fitted to travelling wheels. It is made by Messrs. Selig, Sonnenthal and Co.



PORTABLE LIFTING AND CONVEYING APPARATUS.

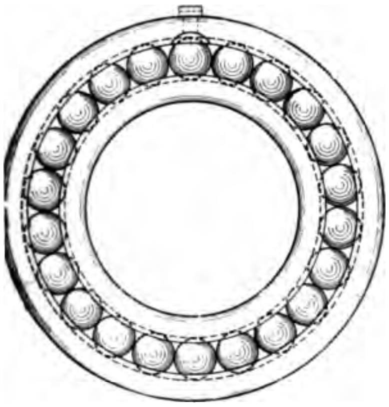


FIG. 1.

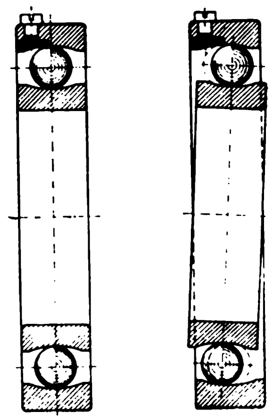


FIG. 2.

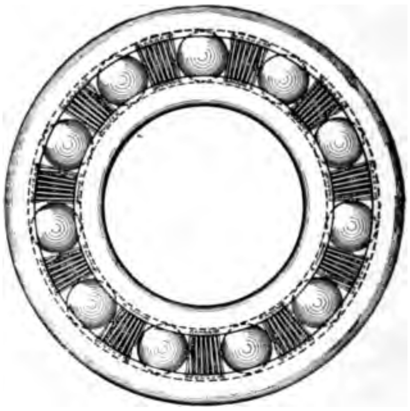


FIG. 3.

Improved Ball Bearings.

The accompanying diagrams illustrate an improved form of ball bearings which the Lahmeyer Electrical Company, Ltd., are fitting with their latest type of small motor for continuous current, in order to bring about a decrease in oil consumption and frictional losses. Hitherto ball bearings of a type as shown in fig. 1 have been used, the space between the outer and inner steel ring being filled with balls so tightly that they touched each other.

Under this arrangement the shaft bends slightly, as shown in fig. 2, the inner ring is no longer running in the same plane as the outer ring, and this causes the balls at the upper and lower parts of the bearings to run on a periphery of smaller radius than in the lateral parts, which means that the balls in the upper and lower parts run slower than the balls in the lateral parts. The balls then knock against each other, and thus lose their circular shape. In the new design, instead of filling the whole space between the inner and outer rings with balls, there is a smaller number, and the space between the balls is fitted with springs as shown in fig. 3. If, in consequence of the bend of the shaft, there is a tendency of the outer ring to get out of truth with the inner ring, the variation in the speed of the balls is counterbalanced by the action of the springs, thus avoiding damage to the bearings. The inside of the spring is filled with felt, which forms a rotating lubricating machine.

The new patent ball bearings are manufactured by the Deutschen Waffen and Munitionsfabriken, Berlin, their agents in this country being Messrs. L. Loewe and Co., London.

Mr. William Barclay Parsons.

The report of the death of Mr. William Barclay Parsons, which has appeared in the columns of several contemporaries, is, we are pleased to hear, without foundation. Mr. Parsons is associated with Sir John Wolfe Barry and Sir Benjamin Baker, upon the London Traffic Commission, and was the engineer chiefly responsible for New York's Underground Rapid Transit Railroad. A short account of his career with portrait, appeared in our issue of the 16th ult.

The Transmission of Wireless Messages.

An important development, which synchronises with the opening of the new year, is the arrangement which has been arrived at between the Post Office and the Marine Companies, by which it has become practicable to despatch from every postal telegraph office in the United Kingdom messages for transmission by the Marconi system from the Marconi Companies' coast stations to ships at sea fitted with the Marconi apparatus. Messages from ship to shore have for some time been passed to their destinations by the overland wires of the Post Office on being handed in by the Marconi officials, but the process of sending messages from an inland telegraph office to a ship at sea via the Marconi shore stations is only now made possible by the new arrangement. Any one desirous of sending a message can obtain at any telegraph office information as to the ships fitted with the Marconi apparatus, the shore stations with which the ship comes into communication, and the hours during which the ship is within range of such shore stations. The whole rate of the transmission will be collected by the Post Office authorities, the land charges being, of course, retained, and the wireless rates handed to the Marconi Companies. The arrangement cannot fail to be of great benefit to commerce, and it should also do much to lighten the burdens of ocean travel.

Engineering Progress in China.

In the course of an article dated from Pekin and entitled "China in 1904," a Times special correspondent chronicles the progress made in railway construction during the year. The main line from Pekin to Han-kau is, he says, completed, except for a bridge across the Yellow River, which is a formidable undertaking, for the foundations are in quicksand. The Canton-Han-kau Railway has not yet been begun, but the German Railway in Shan-tung and the Northern Chinese Railways, under Mr. C. W. Kinder, C.M.G., have been completed, and are thriving exceedingly. The British and Chinese Corporation began the construction during the year of the Shanghai-Nanking Railway, perhaps the most promising line in China, but they still keep locked in their office the concession granted seven years ago for the Canton-Kowloon Railway, an essential line, one-fifth of which is in British territory. Mining enterprise, with the exception of coal mining, shows no extension, the work being burdened with impossible regulations The immense general wealth of the Shan-si province, where there are the richest coal and iron deposits in the world, still awaits railway communication. A narrow-gauge railway to the north of the province is now being constructed by a French company, while in the south of the province the Pekin Syndicate has surveyed a practical route of the highest promise, and will begin the construction of a railway when the negotiations now proceeding in Pekin are completed.

Sir Oliver Lodge *versus* Fog.

Sir Oliver Lodge's attempts to combat the fog evil are worthy of all praise, and even if only partial success attends his experiments, he will have earned the gratitude of Londoners. Sir Oliver states that an electrical method of dissipation is not the right remedy for fog produced by the imperfect combustion of crude fuel, but it is a hopeful and proper method of attacking a natural mist in places where it interferes with navigation or commerce. The electrical remedy may, nevertheless, have to be used in cities as a temporary palliative in times of stress, and while better methods are incubating. The cost of applying such a method to a whole city is probably prohibitory, but there are important centres where any means of mitigating the nuisance would seem to be legitimate. Sir Oliver also offers to show the apparatus to a deputation of municipal engineers at Birmingham. The only trouble is that while fog always appears when it is not wanted, it is impossible to *summon* one for experimentation. However, if the deputation does not go to Birmingham the apparatus will, we assume, be on view in London at no distant date.

An Automatic Blue-Printing Machine.

The accompanying illustration represents an automatic blue-printing machine or photo copier for making copies from tracings by electric light. It is designed to overcome the difficulty experienced in making very long prints such as are required for railway plans and profiles, designs for bridges, ships and other constructional work. Such prints are usually made in sections and joined together, but the result is generally unsatisfactory owing to the diversity of tints in the several sections, the varying shrinkage of the paper in drying which makes it impossible to obtain continuity of the lines.

By the present machine, prints may be made in a continuous piece up to any desired length, while the feeding of the paper and the tracing, the traversing of the lamp across them and the securing of the necessary contact between them, is effected automatically. The rate at which the work is passed through the machine is adjustable through a wide range to adapt it to tracings of different density, and to slow and rapid printing papers, and the whole is driven by a small electric motor.

While primarily designed for the production of long prints, the machine is equally available for short lengths, which are fed in one after another, so that while one is being printed another is being taken out or put in. The machine is being put on the market by Mr. Leonard Shaw, of 39, Victoria Street, London, S.W.

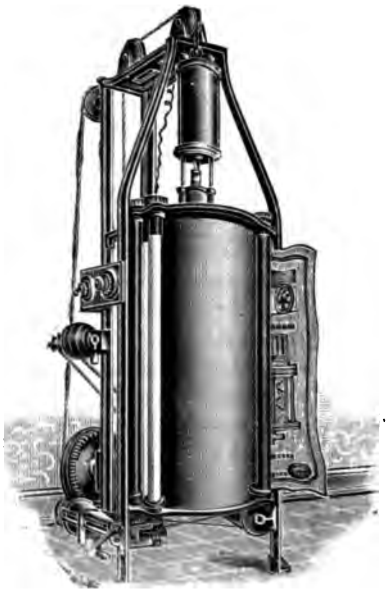


PHOTO-COPYING APPARATUS FOR LONG OR SHORT PRINTS.

NAVAL NOTES.

WEEKLY NOTES ON NAVAL PROGRESS IN CONSTRUCTION AND ARMAMENT.

(BY OUR NAVAL CORRESPONDENT.)

THE remarkable ease with which the changes enumerated in the new scheme of distribution and mobilisation have been brought into being is another testimony to the foresight and attention to detail which has been so noticeable in the policy of the Board of Admiralty under Lord Selborne. The change in the active fleets, as in the reserve, has proceeded along quite normal lines, and the transference of certain vessels from the Mediterranean to the new Channel Fleet will shortly be accomplished. In the Reserve the steps which have been taken are also quite normal, and the preparation for the commissioning of vessels with nucleus crews during the first four months of 1905 are practically complete. It is intimated that the following ships are to be commissioned in Reserve on dates approximating to those given :—

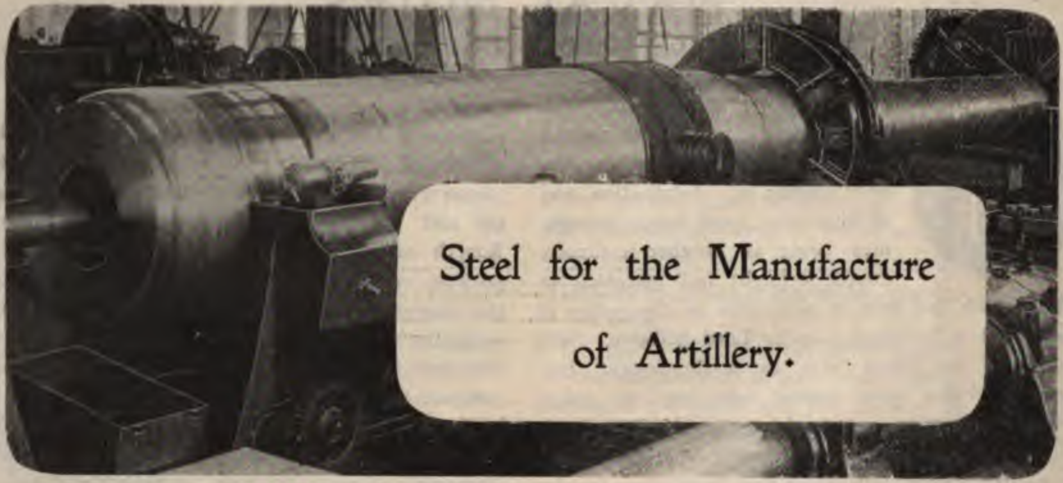
At Portsmouth :—*Cressy* on February 7th, on paying off : *Hindustan* on April 1st, on completion, preparatory to commissioning for active service ; *Renown* on April 4th (commissions at Devonport with Portsmouth crew) ; *Gladiator* on April 4th, after refit. At Devonport :—*Diamond* on January 24th, on completion ; *Edgar* on February 1st, after refit; *Nile* on Feburary 28th after refit; *Empress of India* on February 28th, on paying off ; *Commonwealth* on February 28th, on completion, preparatory to commissioning for active service ; *Carnarvon* on April 4th on completion, *Trafalgar* on April 4th, after refit (commissions at Portsmouth with Devonport crew). At Chatham :—*Dryad* on January 17th, on paying off ; *Sapphire* on January 17th, on completion ; *Royal Oak* on February 7th, on paying off ; *Vindictive* on February 14th, after refit ; *Bacchante* on February 21st, on paying off ; *Talbot* on February 23rd, after refit and *Blenheim* on April 4th, after refit.

The appointments of Admirals to command the squadron in commission in reserve at the Home ports have also been made. Rear Admiral W. H. B. Graham, will be in command at Sheerness, Chatham ; Rear Admiral C. G. Robinson, at Devonport ; and Rear-Admiral R. L. Groome at Portsmouth. A large number of appointments have also been made to certain ships which are to commission immediately with nucleus crews.

One effect of the further consideration of the scheme has been to lead many people to suppose that the preparation of Rosyth as a naval base was to be discontinued and that the whole project would be abandoned. It hardly required Lord Selborne's letter to convince students of naval affairs that nothing of the sort was in contemplation at the Admiralty. Rosyth will serve a well-defined and very useful purpose both in peace and war, and its selection for the purpose of a naval base cannot fail to popularise the Service in Scotland. The cases of Wei-hai-Wei and Rosyth have nothing in common, and to compare them is as futile and unprofitable as it was in the first instance to compare the new station with Portsmouth. It was never intended to make St. Margaret's Hope more than a secondary base at first, whatever might be the ultimate development of its importance, and any slight modification of the original plans has not touched the fundamental objects of the project.

Bearing on the same subject is the closing of the dockyards at Halifax, Jamaica and Esquimalt, Ascension and Trincomalee. None of these establishments are likely to be required even for serious repairs now that the only vessels cruising in these waters will be the ships of the Particular Service Squadron, which will have their base at home at Devonport. Moreover, it is one of the provisions of the new scheme that vessels shall be made to rely on their own resources and not on the aid of dockyard hands for minor repairs, and this will surely be most insisted on in the training squadron.

The British navy starts the new year under favourable conditions. There is, it is true, some appearance of a delay in the completion of the current shipbuilding programme, but work in the private yards is not very pressing just now, and if the contracts for the armoured cruiser *Orion* and the fourteen new torpedo boat destroyers can be given out, there is every possibility that the builders could get them delivered in record time. Completing, and nearly ready for the pennant, there are three battleships and three protected cruisers, and a large number of old and useless vessels are being cleared away. With the college at Osborne in admirable working order, the college at Dartmouth nearly ready for opening by the Prince of Wales, and the complete abolition of of the old insanitary hulks which formerly served as barracks and training establishments, the prospects for the *personnel* are as satisfactory as well could be ; moreover the Navy enters upon the year 1905 knowing that at its head are men of tried and proved ability.



Steel for the Manufacture of Artillery.

BY LIEUT.-COL. CUBILLO (SPANISH ROYAL ARTILLERY).

This article will be the more interesting to readers of PAGE'S WEEKLY by reason of the notes which we published a year ago giving Lieut.-Col. Cubillo's ideas on the reconstruction of the Spanish Navy. Lieut.-Col. Cubillo is a well-known officer of the Royal Spanish Artillery, occupying a prominent position under the Spanish Government. He is of opinion that, with the exception of armour-plate, the construction of the navy can and should be effected in Spain. The article is chiefly intended to show the present state of the iron and steel industry as applied to the manufacture of materials for cannon in the United States.—ED.

AT the present time the Midvale Steel Company, of Nicetown, Philadelphia, together with the South Bethlehem Company, both in the State of Pennsylvania, are the only two which supply artillery materials to the United States Government.

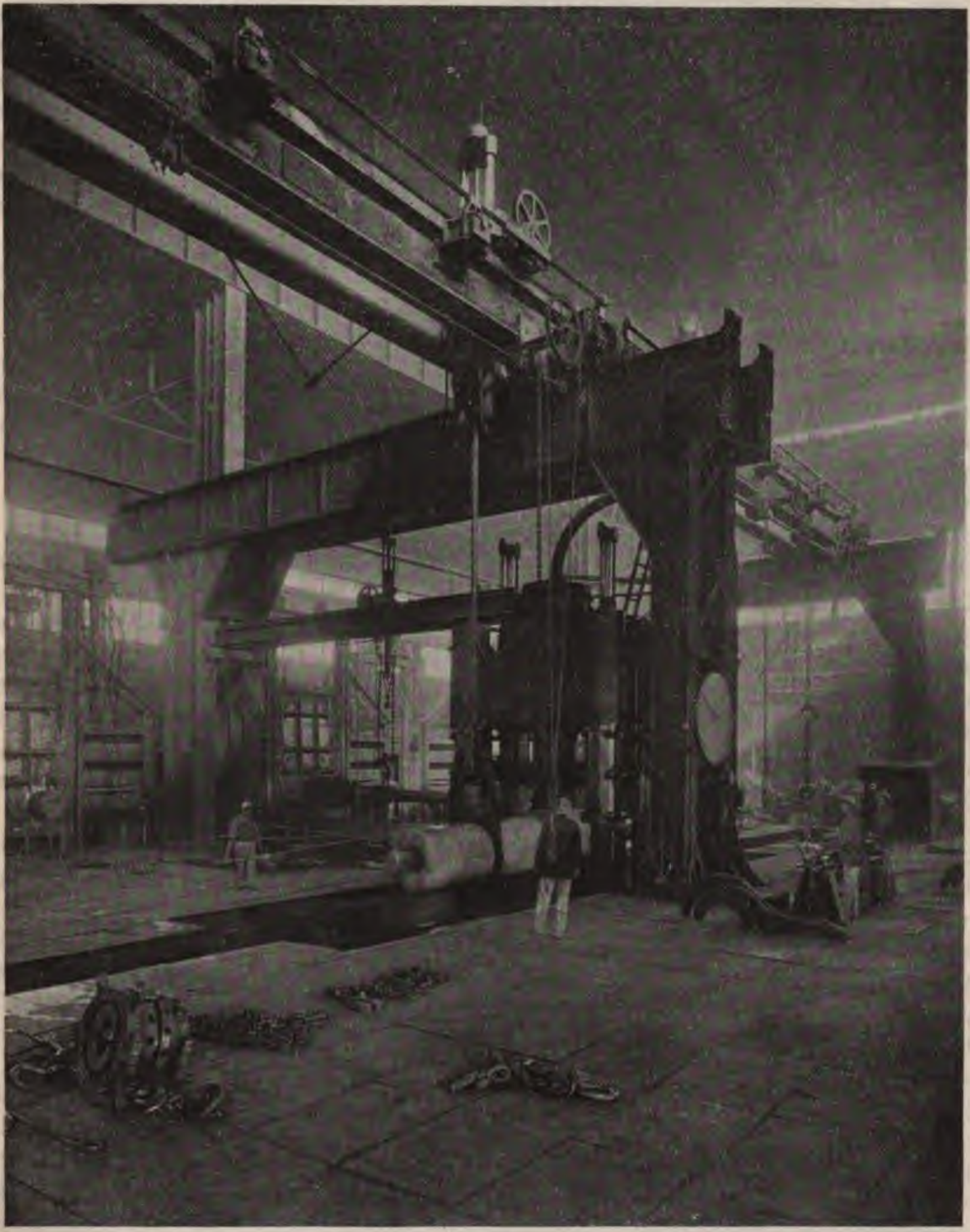
As soon as it was decided that steel should be the only metal employed in the manufacture of United States' artillery, the suggestion was made by a number of people that a class of steel commonly manufactured in that country should be employed, in order to avoid the delay which a thorough training in the making of the class of steel used in Europe would entail. Fortunately, these ideas which would have led to the production of a metal inadequate for artillery use, did not prevail.

At first only a certain tenacity was required in England for inner tubes: durability was not taken into consideration. In France, besides tenacity, a certain percentage of ductility was required. In Germany nothing was known, as Krupp refused to publish his tests.

DEFINING CANNON STEEL.

An American artillery officer, in defining cannon steel, says that it should possess a high elastic limit, good ductility, and strong tenacity to resist the pressure required.

This definition appears somewhat incomplete; he does not take into account the great heat occasioned by the combustion of the powder, nor the friction of the gases at great velocities. In reality it is difficult to make a metal equal to all that is required. It is difficult to produce a metal of great elasticity and ductility with carbon steel. Great elasticity requires a hard metal of great tenacity; great ductility is characteristic of soft metals with a low elasticity. As in many other cases this question has been solved by a compromise, a metal between the



PORTION OF THE MIDVALE STEEL COMPANY'S PRESS SHOP, SHOWING ONE OF THE HYDRAULIC PRESSES FORGING A JACKET FOR 12-IN. RIFLE.

two extremes of hardness and softness has been employed, and to-day the composition of cannon steel has become almost identical in all countries.

The following is the result of tests in the U.S.A. :—

	Elastic Limit. Kg. by MM^2.	Tenacity. Kg. by MM^2.	Ductility. Per cent.	Contraction. Per cent.
Barrels	33	62	17	30
Sleeves	34	64	16	27
Hoops	35·6	64	14	20
Cylindrical Hoops	37·6	65	14	20

Cannon metal has always been called a special steel. In reality it is only special in the same sense as steel for rails, boiler plates, or naval construction. The great difficulty in the elaboration of artillery metal is the enormous masses which have to be handled.

SPECIAL DIFFICULTIES.

The series of operations necessary in order to convert the ingots into barrels, sleeves and hoops present great difficulties in the uniform heating of the pieces. In the case of the barrels furnaces of twelve or fourteen metres in height are necessary, and a uniform temperature is far from easy to obtain, even with many injections of gas. All these pieces are extraordinarily sensitive to the action of heat, and when submitted to the high temperature of the hardening furnace. Even when part of the tube is subject to the heat of the sun and the other part is in the shade, a slight twist is occasioned. For this reason, when the Minister of War gave Messrs. Niles an order for the construction of several steel howitzers, he insisted that the factory where they were to be made should be of a uniform and constant temperature.

In general the Americans obtain their artillery steel with 0·45 to 0·50 per cent. of carbon. This is what Trubia is attempting to do. As regards the quality of manganese and silica, it is also in about the same proportion, especially manganese which approximates to about 0·60 per cent. in American and Spanish steel.

INTRODUCTION OF NICKEL.

The American artillery makers do not limit themselves to carbon steel in the manufacture of all classes of guns. The mechanical qualities of nickel were observed. This metal is now employed in all breech screws, and in rapid-fire guns of 5 and 6 calibre. An elastic limit of 50 kg. per square millimetre for breeches, and 46 kg. by square millimetre for rapid-fire guns is required.

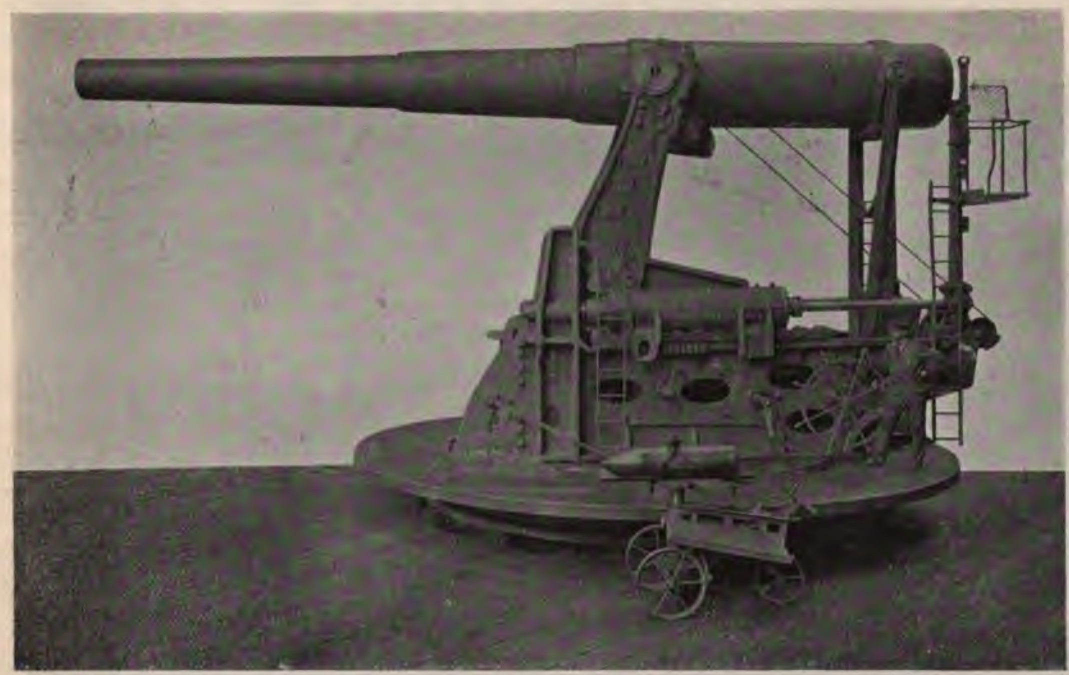
The most commendable quality of nickel steel is its high elastic limit with small quantities of carbon.

After the difficulties of fusing and forging of nickel steel have been overcome there still remains the machine work—no light task, judging by the waste of cutting tools.

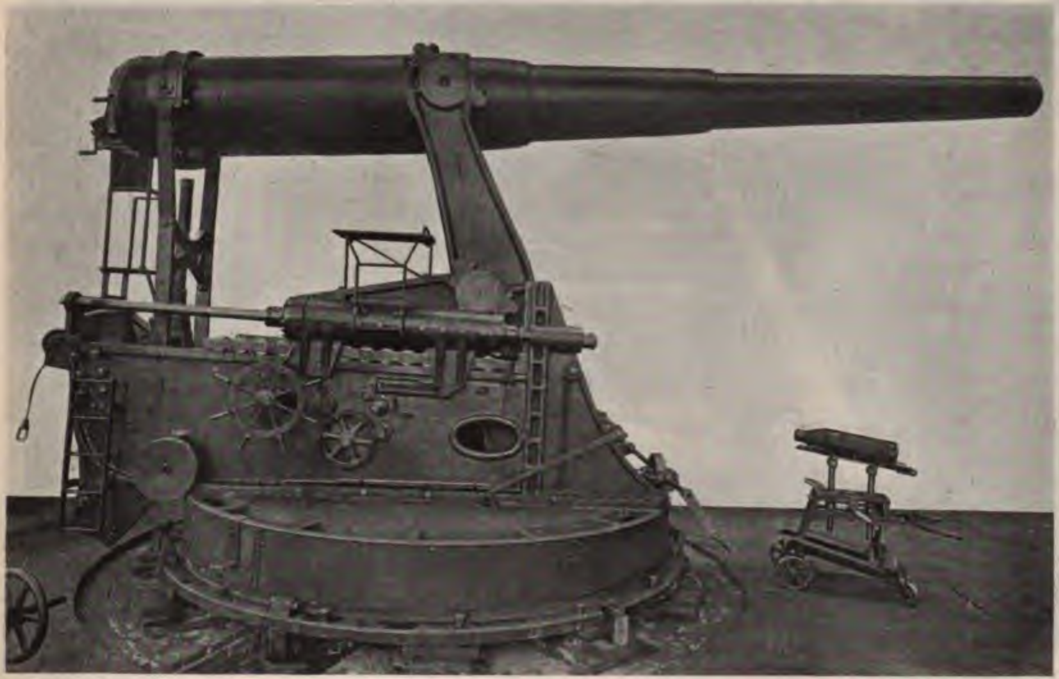
THE MIDVALE FACTORY.

This factory, almost entirely devoted to the manufacture of cannon, steel-castings, and projectiles intended for the army and navy, is situated in Nicetown, one of the suburbs of Philadelphia. Founded in 1866 it first gave its attention to the making of locomotive wheel tyres with crucible steel. Later a rolling mill was installed to produce the wire required for the St. Louis and Brooklyn Suspension Bridges. Subsequently the business was reorganised, Siemens' furnaces being erected and the making of locomotive tyres was again taken up as well as other forged piece for engines and other similar objects. Attention was also paid to steel for rifles, and the greater part of the materials used by the Springfield factory, including those for cannon proceeded from the Midvale Foundry.

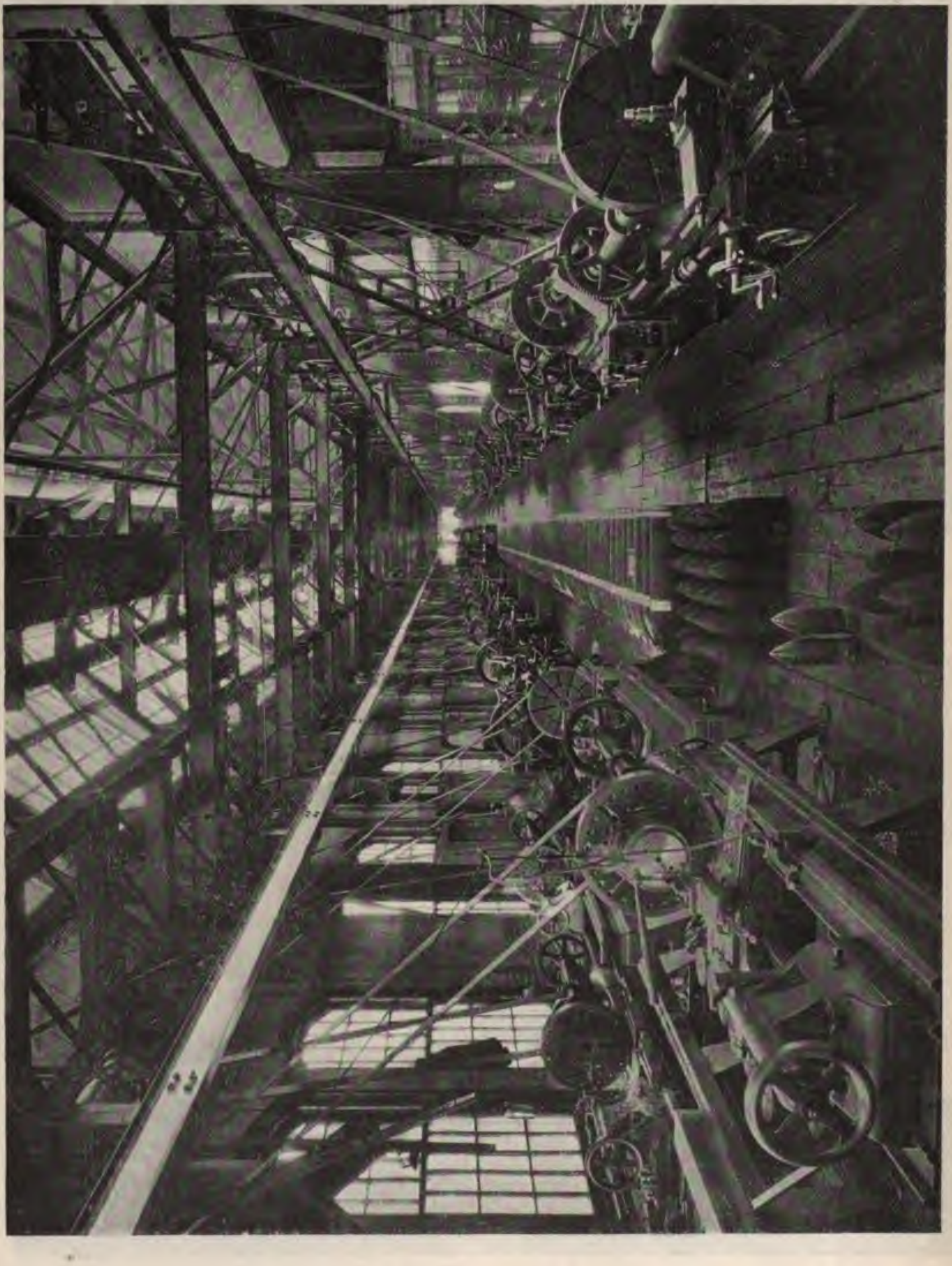
The first attempt to manufacture artillery materials took place in 1877, when several short tubes were provided to line several Parrott guns of 100 and 65 lb. The results, judging by the tests made, were very satisfactory; later, in 1878, they delivered a long barrel of soft metal for the conversion of a 25 centimetre Parrott gun to a rifled one of 22 centimetre.



ONE OF EIGHT 12-IN. BREECH-LOADING RIFLES AND DISAPPEARING GUN CARRIAGES BY THE MIDVALE STEEL COMPANY, PHILADELPHIA, PA.



ONE OF FOUR 10-IN. BREECH-LOADING RIFLES AND DISAPPEARING GUN CARRIAGES BY THE MIDVALE COMPANY.



PROJECTILE-TURNING DEPARTMENT OF THE MIDVALE STEEL COMPANY, PHILADELPHIA, PA.

Eventually, in 1882, they received a contract from the Washington Arsenal for the materials for 15-centimetre guns, one to be hooped with steel wire, the other to be hooped with steel. This gun, the first of 15 centimetre to be constructed entirely of American steel, gave excellent results when tested at Annapolis. It is clear that these materials wrought by a hammer of only nine tons, the most powerful possessed by the Midvale at the time, could not equal the product obtained to-day, but the experiment was a good beginning and persuaded the Company to instal the modern plant necessary for the construction of big guns.

The transformation of the Midvale Company was complete. New Siemens' furnaces of great capacity replaced the old ones, three in number, which, together could only produce ingots of thirty-four tons. A 34-in. Whitworth press replaced the steel hammers.

This press exerting a pressure of 2,500 tons, enabled the Midvale Company to turn out thirty centimetre guns in 1884-1886. The accessories of the press, pumps, cranes, pulleys and shafting, pedestals, anvils, tube expanders, and other forging tools, were similar to those used by Whitworth, now well known at Trubia.

A more powerful press is to be installed at Midvale to facilitate the making of the 30 and 33-centimetre guns. The hardening department, in which oil is used, is well mounted and capable of handling the largest pieces constructed at the present time.

The machine shops are well provided with powerful machines and tools from the best American manufacturers. Midvale does not make use of fluid compression, differing entirely in this respect from the Whitworth process.

They employ excellent first materials in the preparation of the loads for its Siemens' furnaces; the steel destined for the making of guns and armour-piercing projectiles, prepared on an acid bed, necessitates the use of Swedish ingots or other charcoal pig iron of great purity as regards sulphur and phosphorus. The coke pig irons of Europe and America cannot be employed without risk of bad results. A few years ago, when the Campanil ore was worked in the Bilbao, the Trubia factory used the coke pig irons with good results. Conditions have changed, however, pure ores have decreased in the Bilbao district, and even other Spanish charcoal pig irons are not employed, as, although they possess purity in regard to sulphur, they contain as much phosphorus as coke ingots.

At Midvale the steel ingots are smelted in ordinary metallic moulds, octagonal in shape, with concave faces, and others in refractory moulds, an example followed by some other establishments.

The hardening of the various pieces is done in oil, the furnaces being vertical and fired by gas.

At first it was thought it was not so necessary to take much care in the selection of materials for steel castings as in the case of wrought or rolled. It has been found, however, that phosphorus is equally as prejudicial in a casting as in a wrought or rolled piece, and a limit of 0·05 per cent. has been exacted.

The conditions exacted by the American Government regarding steel casting for the army and navy are: the amount of phosphorus must not exceed 0·06 per cent., and as regards calorific treatment, that the pieces should be reheated unless ordered to the contrary.

Midvale also manufactures armour-piercing projectiles of chromo-nickel steel, but their tempering process, of the greatest importance in this speciality, is kept secret. They are not limited to the manufacture of gun materials, but construct disappearing carriages for coast defence, having reached a calibre of 30·5 centimetres.

(*To be continued.*)

LAUNCHES AND TRIAL TRIPS.

COMBINED BUCKET AND PUMP DREDGER.

Messrs. William Simons and Co., Ltd., Renfrew, have just launched, complete with steam up and ready for work, a very powerful dredging vessel of their latest design. The boat is named the *Murikiku*, and she has been built to the order of the Agent General for New Zealand. Besides being fitted with a special set of buckets for dredging rocky ground, the vessel is fitted with a sand-suction pump. The buckets as well as the suction pipe are made to dredge to a depth of 40 ft. The hopper is arranged in such a manner that the dredgings can be relifted from the hopper and discharged over the side by a special patent arrangement of the builders, and delivered ashore through a long line of floating pipe for land reclamation, or into barges moored at the side of the dredger. Ordinary hinged doors are also fitted to the vessel's own hopper, so that the material can be deposited at sea when required. The machinery consists of two sets of triple-expansion engines and two cylindrical boilers of 160 lb. working pressure.

A STEAMER FOR CUBA.

The new steel screw steamer *Regina* left Messrs. Workman, Clark and Co., Ltd., fitting-out basin at Milewater Wharf, Belfast, last week, for a trial cruise in the Belfast Lough, prior to her departure for Havana. The *Regina* has been built and engined by Messrs. Workman, Clark and Co., Ltd., to the order of Messrs. R. Truffin and Co., of Havana, and is designed to carry molasses in bulk between ports on the Cuban coast and the States. The propelling machinery, which has been constructed by the builders at their engine works, consists of a set of triple-expansion engines with all necessary auxiliaries, supplied with steam by two cylindrical multitubular boilers.

THE HUMBER.

Earle's Shipbuilding and Engineering Co., Ltd., of Hull, launched on December 30th, the *Lucy*, a handsomely modelled steam trawler, built to the order of Messrs. Moodys and Kelly, Grimsby, for the Fleetwood Steam Fishing Company, Ltd. Her dimensions are 126 ft. 8in. by 22 ft. by 12 ft. 10½ in. moulded, and she will be fitted with triple-expansion engines, having cylinders 12¾ in., 22 in. and 36 in. diameter by 24 in. stroke, supplied with steam from a large steel boiler working at 180 lb. per square inch.

THE CLYDE.

There was launched on the 21st ult. from the yard of Messrs. Murdoch and Murray, Port-Glasgow, a steel awning decked twin-screw steamer for cargo and passenger service on the River Amazon. On leaving the ways the vessel was named *Barao de Cameta*, and was taken in tow to James Watt Dock, Greenock, where she will be fitted by Messrs. J. G. Kincaid and Co., with compound engines. This is the fourth steamer built by this firm this year for the Amazon.

WEST HARTLEPOOL.

On the 22nd ult, Messrs. William Gray and Co., Ltd., launched the steel screw steamer *Jethou*, for Messrs. A. N. Hansen and Co., Copenhagen. She will take the highest class in Lloyd's and Norske Veritas, and is of the following dimensions, length overall 381 ft. 6 in., breadth 50 ft., depth, 28 ft. 4½ in. with long bridge, poop, and topgallant fore-castle. Triple-expansion engines are being supplied by the Central Marine Engine Works of the builders, having cylinders 26 in., 42 in. and 70 in. diameter, with a piston stroke of 45 in,. and two large steel boilers for a working pressure of 80 lb. per square inch.

SELBY.

There was launched from the shipyard of Messrs. Cochrane and Sons, shipbuilders, Selby, on Saturday, the 24th ult. a handsomely modelled steel screw trawler, the principal dimensions being 120 ft. by 22 ft. by 13 ft. The vesel has been built to the order of Mr. H. P. Aspeslagh, of Ostend, Belgium, and will be fitted with powerful triple-expansion engines by Messrs. Charles D. Holmes and Co., of Hull. She is fitted with all the latest improvements for this class of vessel.

Dockyard Coal-Handling Plant.

Graham, Morton and Co., Ltd., of Leeds, have obtained the contract for the supply, delivery, and erection at the electrical generating station at His Majesty's Dockyard, Devonport, of a complete coal-handling plant, including coal bunkers, stanchions, girders, flue, and coal measuring and weighing apparatus, and all accessories. All materials used are to be of British manufacture throughout, of the best of their respective kinds and workmanship.

PRACTICAL NOTES ON DRILLING HOLES.

BY VALENTINE RYAN.

THE disadvantages under which a drilling machine performs the work allotted to it, as compared to the other machine tools, are often overlooked. Usually, the latter are machining on "the working parts" of the plants they deal with; these parts are machined on all sides, so their ultimate shape is quite independent of the character of the casting. In these a certain amount of surplus material was provided, so as to permit of some flexibility in marking-off and machining the initial surface. The surface thus obtained is available as a groundwork for all subsequent marking-off and machining; when chosen with discretion it leaves little difficulty for obtaining the other dimensions of the casting to the required degree of accuracy. Thus, unless the casting be an awkward one, there is little excuse for being at fault in obtaining the initial surface, and once this is available, the remainder of the work is greatly facilitated. Very often the drilling of a hole is analogous to performing the second stages of the machining to the same degree of accuracy as before, without the aid of a finished groundwork; this is especially so when holes are required in castings upon which little machining has been done. Working with other machine tools, one can often trace the course the tools will take throughout its travel, the object being to obtain a surface of which one can outline, say, two or three sides; in place of this, how often, when drilling a hole one has to work to a mere centre.

The second surface of a casting must be machined accurately to the first, the third equally so to the first and second, and the fourth to the first, and either the second or third surface. The greater degree of accuracy that is required, the better are the facilities for obtaining it. Thus, a polyhedron is obtained by a series of distinct operations; in practice the error permissible is gradually reduced, and is amply compensated for by the increase in the facilities afforded. In drilling a hole, a cylindrical surface has to be obtained in a single operation, and so is without the aid of any equivalent process for eliminating the error, or any increased control over the casting. In turning, a little surplus material obviates the degree of accuracy in much the same way, but the minute accuracy to which the slide-rest works to the line round which the material revolves, results in the production of accurate work. In this case, also, a cylindrical surface is required, but it is procured by slow degrees, the dimensions required being attained gradually. During the latter stages, a perfectly satisfactory surface to work to is available and the cylindrical surface bears a uniform ratio to that which has to be obtained; or, in other words, the error is first reduced to a uniform one, it then being a comparatively easy matter to deal with the latter. Rimering a hole is analogous to this, but only in exceptional cases do circumstances permit of this being done. Admitted that there are some methods of rectifying errors made in drilling holes, they at the best of times only effect a compromise. Accuracy is really only attainable by the drilling machine performing the work correctly in a single operation; so, compared with the other machine tools, it is handicapped to a greater extent than one has been accustomed to think.

SPECIAL DIFFICULTIES.

To drill a hole is one of the easiest operations a mechanic has to perform, yet it occasionally calls for the exertion of much ingenuity and care. This happens when the hole must occupy a well-defined position throughout its length with one, two, or, perhaps, three, sides of the material in which it is drilled, especially when the latter affords no satisfactory surface to work to. The most obvious expedient is to work to a standard set of templates, as is adopted to some extent in all works. It is not easy to explain why this cannot be followed to a greater extent than is found possible; there are always some well-founded reasons for doing so, not apparent at first sight. Sometimes a *modus operandi* is discovered that diminishes the difficulties considerably: usually an undue amount of time is wasted before a satisfactory one is arrived at. Some of the precautions adopted and arrangements found convenient when difficulties of this kind are encountered should be welcome. Those dealt with in this article may be modified in various ways, as suggested by each one's experience, or for the special requirements of the work upon which they are engaged.

A RELIABLE DRILL-GAUGE.

A reliable drill-gauge is a great help, and of these there are many on the market: mechanics usually prefer those having only the range of holes met with in their particular work for which reason many make a gauge for their own use, drilling a few holes now and then when a suitable opportunity offers. That shown in fig. 1 will be found of special service to brass-finishers, and by using the dimensions given the gauge will appear symmetrical. If they are reduced, the holes are liable to get distorted in tempering. The figures may be inscribed upon the gauge by coating it with paraffin-wax, being careful to completely fill the holes, and tracing out the figures with a fine pointer. After being left in sulphuric acid for, say, half-an-hour, the figures will be found clearly outlined in the steel.

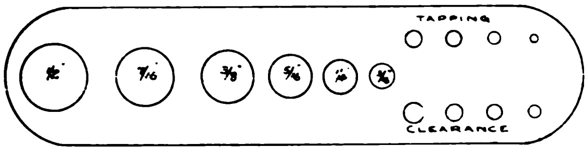


FIG. 1. DRILL GAUGE.

When working with B.A. screws in brass, the drills for tapping one size of hole can be conveniently used as a clearance drill for the next smaller size. So 5 B.A. tapping is just the right size for 7 B.A. clearance; working in iron, the 7 B.A. clearance is a shade too small for 5 B.A. tapping, the iron being more brittle, the tap should only be allowed to remove as little surplus material as possible. Working with iron matters must be cut much finer; brass-finishers now and then overlook this point, and broken taps are the result.

DRILLING SMALL CASTINGS.

Holes are sometimes required to be drilled and tapped in the centre of circular pieces of metal the latter are often placed in the chuck of a lathe and the drill fed with the back-centre; the centre of the back of this drill is grooved out, as shown in fig. 2. Owing to constant pressure, the centre of the groove will run out; to prevent this a smaller hole is drilled, say 3/16 in. deeper: this is sufficient to guide the centre when the groove wears.

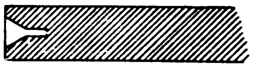


FIG. 2.

Many small castings are required to be drilled between centres, and yet it is not found expedient to work in a lathe. A centre, as shown in fig. 3 screwed on to a drilling machine, is of great service for such work. A pair of washers are provided to facilitate the setting of the centre in line with the drill: in the majority of shops this plan of working between centres in a drilling machine seems never to have suggested itself. It is surprising how easy this simple device will render awkward jobs.

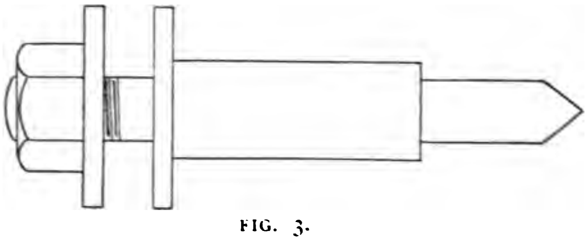


FIG. 3.

Occasionally it is difficult to drill two holes in the exact relative positions required; such a difficulty may sometimes be overcome by drilling one hole first, plugging it with a piece of brass, and finding the centre of the same; then using this new centre to mark-off the position of the second hole. In fig. 4 is shown a template in which the bottom of a big hole B is required to be flush with the surface of A; the second hole C being required in the exact centre of B. This is rendered easy by confining one's attention to drilling B in the position required, and marking-off the centre of C as described.

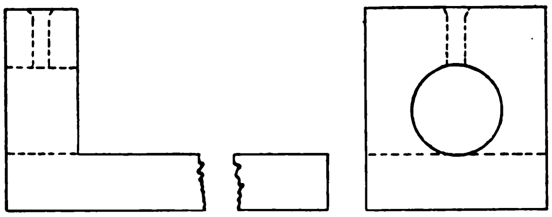


FIG. 4.

SMALL HOLES IN BRASS STAMPINGS.

Drilling small holes in light brass stampings entails much time and expense; manufacturers avoid this by stamping out as many holes as possible. To ensure good work, a sample stamping is taken, work marked-off, and, perhaps, templates made from it; it will be subsequently found, when the material is assembled and fitted together, that the position of a considerable percentage of the holes in quite inaccurate. The result is that many of the light screws in the equally light stampings have to be screwed hard, and the threads on either not infrequently stripped. It would not be safe to estimate the quantity of material wasted in this way—workshop managers do not object to seeing a few big barrels full of such stampings. Nearly all this waste is due to the sheets of metal out of which the stampings are made being slightly buckled; at the moment the holes are stamped the plate is pressed out, and when free again the metal springs back into its former shape, thus altering the relative position of the holes.

Placing steel centres round the holes in gigs repays in all cases; when a little experience is obtained in doing so, the loss of time involved is small indeed. The gigs should be well tinned in and about the hole, the steel centre placed in position with a few small chips of solder around it; a small blow-pipe flame will quickly melt these, and the whole should be instantly dipped into water. This method has the following advantages:—

1. It does not alter the temper of the steel, as so small an amount of heat is required;

2. It provides the necessary solder with no surplus, thus making a neater job; and

3. The steel centre can be fixed firmly in position, there is no liability of altering the same.

When drilling small holes in round rods in a gig, the drill being small, is flexible, and so is liable to "run out." This may be avoided by making the steel centres $\frac{5}{16}$ to $\frac{7}{16}$ in. high, which provides extra bearing surface, keeps the drill true, and lessens the liability of it being broken.

CASTINGS WITH ONLY ONE SIDE AVAILABLE.

Occasionally castings are met with which have only one side on which work can be done, their shape rendering the other side inaccessible. This difficulty can be overcome by making a hollow gig to hold the casting in a fixed position, and then drilling the holes in it, thus permitting of the only side available being utilised to fix the casting in position, and at the same time, enabling the holes to be drilled in that surface. A typical example of making one side of a casting fulfil a twofold purpose is afforded by the master-chuck shown in fig. 5. This is screwed on to the headstock of a lathe, and is designed to hold a casting on the surface

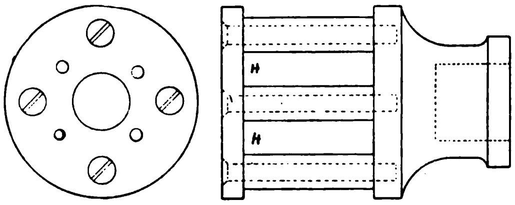


FIG. 5. MASTER CHUCK.

HH by means of screws in the holes shown; the large holes in the centre of the chuck enables the casting to be turned out. Positive carbon holders for arc lamps, with a neck on the top to hold the washers round the carbon in position are made in this way.

OTHER EXAMPLES.

When pedestals are required to be fixed to bed-plates, the oval-shaped holes in the former afford the useful means of adjustment; where such holes will not be permitted, the degree of accuracy in the drilling must obviously be great. To secure this accuracy scribers with pointers at the end (fig. 6) are made an easy fit, so that they will freely revolve in the holes in the pedestals. The latter are set in position by a long scriber fixed in a trial-bar, and the position for the holes in the bed-plate outlined by such a scriber. Balancing booster sets, consisting of four armatures directly coupled together, thus forming one long shaft running in five bearings, can have the position of the pedestals determined by this means with surprisingly accurate results.

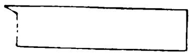


FIG. 6.

To afford the necessary guidance to the drillers it is a common practice to make four centre-punch marks at equal distances on the circumference of circles of the size of hole required. Beginners frequently make the marks of unequal size, which tends rather to deceive the drillers, as after the drill has been at work for a few moments, the driller looks for the remains of the marks. If one, or perhaps two, are bigger than the remainder, he proceeds to draw the hole in the direction of the former.

Holes are sometimes met with that are required to be slightly bigger at the bottom. This can be effected by drilling the hole with a V-shaped drill, and then grinding the drill out of centre, when the depth of the hole is near that required.

To make a presentable job of fitting oil lids on pedestals is not so easy as would appear, gigs or templates cannot be recommended for such work. The only satisfactory plan is to fit the lid on temporarily, leaving some surplus material on the bosses, the lid can be set and holes drilled in what may appear to be the correct position. By finishing the doors afterwards any inaccurary in the drilling can be overcome as far as the appearance of the job is concerned, which method of working, though not a straight one, is too often overlooked.

ADVANTAGES OF TWIST DRILLS.

Twist or fluted drills work quicker under given conditions than V-shaped ones, a fact that is clearly recognised by mechanics, but a satisfactory explanation is not really obtainable. The following reasons have suggested themselves to the writer. A big percentage of the work done in drilling holes is expended in driving the point of the drill by small stages deeper into the material. Owing to the large bearing surface of the twist drill in the holes, this penetrating power is kept concentrated in one spot, and once a slight opening is made, the centre of the drill is kept fixed on that point, thus affording the cutting edges an opportunity of attacking fresh material. With a V-shaped drill the point is pushed from side to side by the cutting edges, while owing to frequent grinding, the cutting edges of V-shaped drills are usually at different angles to the centre line of the drill consequently one cutting edge will not follow up the work done by the other; with twist drills the tendency is to distribute the work more evenly. As the grooves occupy symmetrical positions round the centre of the drill, so each cutting edge seconds the efforts of the one that preceded it in removing the material. The grooves of twist drills afford a satisfactory sliding path for the material to reach the surface, leaving the cutting edges freer to attack fresh material.

125,000 H. P. Electrical Plant of the Toronto and Niagara Power Company.

(*Continued from page* 693.)

THE large gathering dam will ensure a supply of close on 2,000,000 cubic feet of water per minute, The needs of the station of the Toronto and Niagara Power Company are estimated at 700,000 cubic feet. The overflow will pass over the top of this dam in a cascade, thus adding to the picturesqueness of the Falls.

The water thus gathered will be conveyed downward through steel tubes to the water-wheels located in the bottom of the wheel-pit, and the differences of level provided by the design are such that, after deducting losses from friction, and the velocity of approach and discharge, there will remain an operating head of 143 feet to be used by the turbines. The wheel-pit is provided with masonry lining, the provision that the turbines and all the machinery above them shall rest upon solid rock foundations, instead of artificial supports, as has hitherto been the practice is an element newly adopted for this construction, and the value of which is apparent.

As has been the case elsewhere, the formation of ice during the winter months is one of the serious problems which confront the hydraulic engineer at Niagara Falls. The site which has been selected for the power house is one which is believed to offer less trouble from this cause than any other existing or contemplated plant at the Falls. Moreover, before the water reaches the turbine chamber it will have to pass through two rows of submerged arches and then through a rack, by which means ice and floating debris will be kept clear of the pumps.

The main tunnel will be about 25 ft. in diameter, speaking roughly. At present it is being heavily timbered foot by foot, as the heading is blasted out.

The labourers are mainly Italians and coloured men here and throughout the works, and there are also a number of French-Canadians.

A glimpse of the Falls which few people are privileged to obtain is to be had from the mouth of the tunnel. The curtain of water is about 60 ft. from the base of the rock at this point, the roar of the falling water and the spray which is hurled up in clouds, combining with the wind, give an idea of resistless force which leads the beholder more than ever to wonder how the works he sees around him could have been carried out.

In the design of the tunnel, consideration has been given to the fact that the Horseshoe Falls are constantly receding. The lining of the first three hundred feet from the outlet will be put in in rings of 6 ft. long, so that as the Falls recede and the tunnel shortens by the breaking away of the surrounding rock the lining will break away in clean sections and leave a smooth surface at the new end of the tunnel. This will also prevent the cracking of the lining back of the point where the tunnel breaks away. For the rest of the distance, the lining will be of hydraulic pressed brick.

In the crown of the tail-race tunnel there will be constructed a light gallery for observation purposes allowing an inspection of the interior at any time without having to shut off the flow of water.

THE POWER HOUSE.

It is asserted that there will be no power-house in the world to compare with that for which the Electrical Developments Company have had plans drawn. By its agreement with the Government, and the Victoria Park Commissioners, the company was bound to erect a building which should not detract from the appearance of the Park. The style of the Italian renaissance has been adopted by Mr. E. J. Lennox in the plans, which the Government and the commissioners have approved. The building will be about 500 ft. long, 70 ft. wide, and 40 ft. high. As it will only be a few yards from the electric car line, and affords an excellent view of the rapids, just above the Falls, there is little doubt but that the power-house will become one of the sights of the Falls.

For the above information our thanks are due to the Electric al Development Company, of Ontario, Ltd., and their Senior Assistant Engineer, Mr. Julian, Thornley.

OUR WEEKLY BIOGRAPHY.

SIR JOHN ISAAC THORNYCROFT, F.R.S., LL.D.

SIR JOHN ISAAC THORNYCROFT, the designer and builder of the first torpedo boat for the British Government, was born February 1st, 1843, in Rome, where his parents, both sculptors, resided for the purpose of studying their art amongst the marbles of the Vatican. Although an artist of considerable distinction, the elder Thornycroft was greatly interested in engineering problems, a characteristic which was also demonstrated at an early age by his eldest son John, whose tendency in this direction was enthusiastically encouraged by his father. He was educated at private schools and when only seventeen years of age he constructed from his own designs the steam launch "Nautilus," the principal dimensions of which were: length, 36 ft.; beam, 5 ft. 10 in. The young engineer's vessel was a complete success and fully justified the general interest it evoked.

In 1864, having attained his majority, Mr. Thornycroft founded the shipbuilding yard at Chiswick which bears his name. Here he began to build small launches and to concentrate his energies on the further development of the principles of construction for which he had already established a reputation.

After building a number of vessels he temporarily abandoned construction work in favour of an appointment in the shipbuilding yard of Messrs. Wm. Palmer at Jarrow. Here he gained much valuable experience. He then entered the University of Glasgow and underwent a course of studies in engineering and mathematics. Shortly after the completion of his University career he returned to Chiswick with a well-grounded knowledge of theory combined with practical experience.

His next venture was the launch of the "Miranda," the importance of which may be gathered from the fact that Lord Armstrong and Sir Frederick Bramwell journeyed specially to Chiswick in order to witness its evolutions, and the latter, in 1872, discussed the "Miranda in a paper contributed to the transactions of the Society of Naval Architects.

Mr. Thornycroft's reputation as an inventor was further enhanced by the completion of the "Gitana," a vessel which had the closed stoke-hold with forced draught, locomotive boilers and engines which united strength and lightness in what was then the most desirable degree.

Subsequent years to a great extent were spent in transferring the principles of the "Gitana" to the torpedo boat, giving rise to an industry of which Sir John is the founder. Amongst his inventions may be mentioned the Thornycroft double rudders and the screw turbine for shallow-draught vessels. Sir John is also the inventor of an apparatus for steadying the roll of ships, and he designed and constructed motor steam-wagons shortly before the passing of the Act which legalised their use in this country; later on he designed steam-wagons which in competition gained several gold medals, and in 1902 won the £500 prize offered by the War Office for the best motor-driven vehicle suitable for military purposes. But his fame as an inventor is chiefly associated with the development of the water-tube boiler. Of course, in some measure, the principles of this invention were theoretically already known, but to Sir John Thornycroft belongs the distinction of perfecting the scheme and making the utilisation of the water-tube boiler advantageous. As will be remembered, the boiler was shortly afterwards adopted by the Admiralty on an extensive scale, and it gradually met with universal approval.

Sir John Isaac Thornycroft is the Vice-President of the Institution of Naval Architects; Member of the Council of Mechanical Engineers: Member of the Council of the Institution of Civil Engineers, and a Member of the Committee of the Automobile Club.

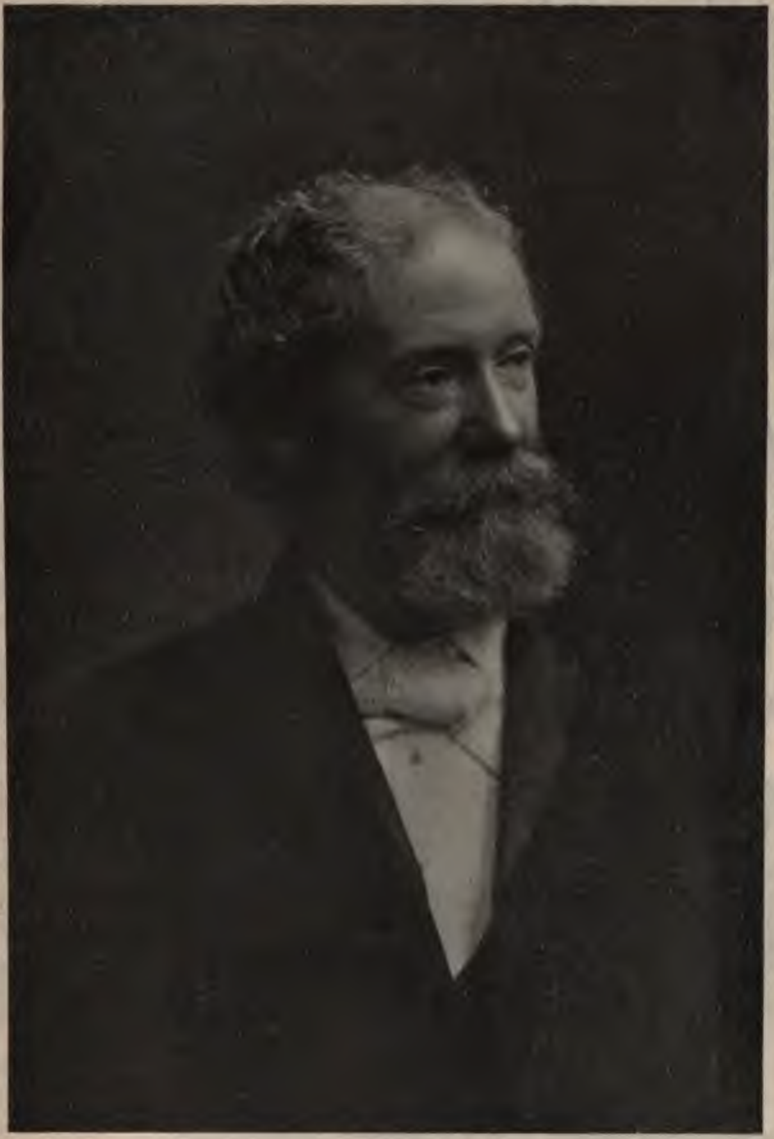
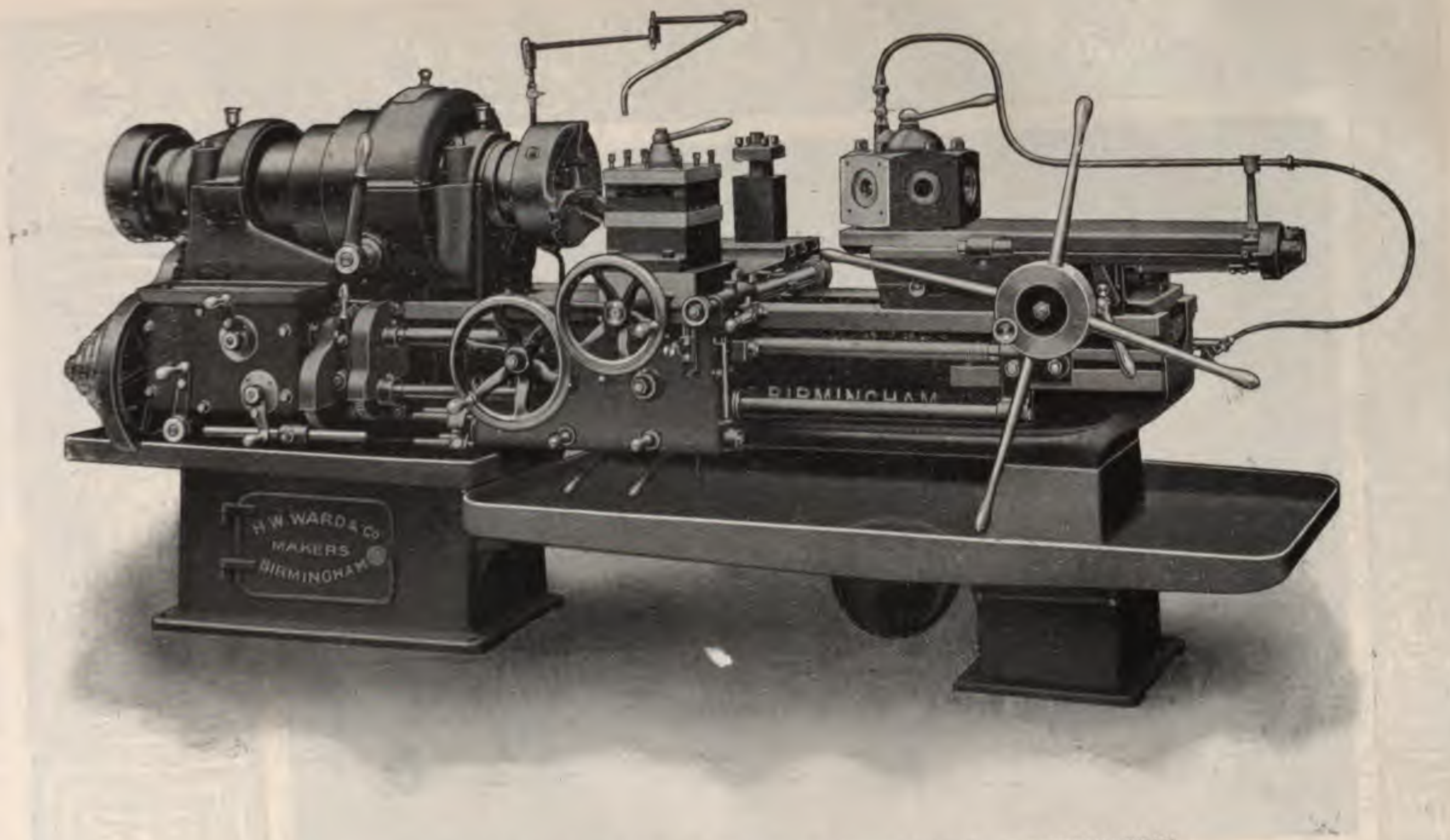


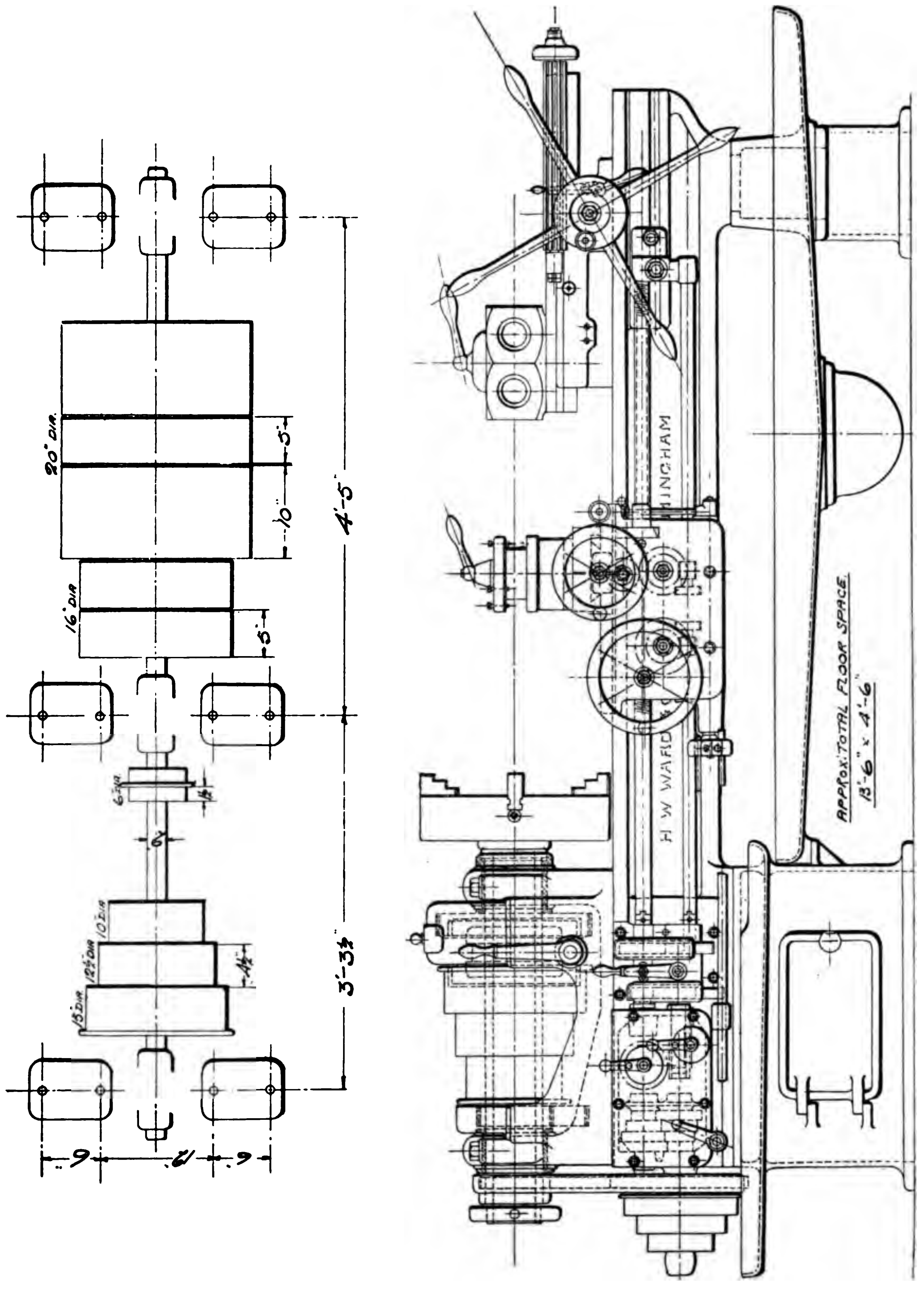
Photo by Elliott and Fry.

SIR JOHN ISAAC THORNYCROFT, F.R.S., LL.D.



11-IN. CENTRE CAPSTAN LATHE BY MESSRS. H. W. WARD AND CO., OF BIRMINGHAM.

The capstan is hexagonal in form 10½ in, across its flats, and tools may be attached to it either by a round shank, or to its flat faces by means of four screws or studs. Six stops are provided one for each tool, and the mechanism operating these is geared positively to the turret, so that whichever way the turret is turned, the right stop for each particular tool is always brought into position. (*See page* 26.)



PLAN AND ELEVATION OF NEW CAPSTAN LATHE BY MESSRS. H. W. WARD AND CO., OF BIRMINGHAM.

Total length of countershaft, 8ft. 6in. Speed of countershaft, 80 and 250 revs. per minute.

11-in. Centre Friction Geared Capstan Lathe

By Messrs. H. W. Ward and Co., Birmingham.

WE illustrate on pages 24 and 25 an 11-in. centre capstan lathe made by Messrs. H. W. Ward and Co. This machine is particularly adapted for machining steam engine parts, gas engine parts, motor-car details such as pistons, change gears, bevel wheels, gear covers, etc., etc. The large hole through the spindle is 4⅝ in. diameter, enabling the lathe to be used for making gear blanks, ballraces, etc., up to the size of the hole, from bars, which is of course a much more economical method than making them from forgings.

The headstock carries a hardened steel spindle, which runs in parallel adjustable gun-metal bearings. It is driven by a three-speed cone pulley of large diameter carrying a belt 4½ in. wide. The gearing is of the power 8 to 1, and with the two-speed countershaft which is supplied gives twelve changes of speed to the spindle. The change over from belt to gear drive is accomplished by means of the lever in front of the headstock. This operates a friction clutch, which may be moved over while the lathe is running.

The capstan rest is arranged to move along the bed, and to clamp in any desired position by means of two bolts and keep plates. The top slide is very stiff and extra long, giving a useful traverse.

The total traverse may be used for exceptionally long jobs by throwing the automatic revolve motion out of gear, and revolving the turret by hand—a very useful feature which is seldom found on this class of tool.

The capstan itself is hexagonal in form 10½ in. across its flats, and tools may be attached to it either by a round shank, or to its flat faces by means of four screws or studs, this offering a very secure method of holding large and heavy tools. Six stops are provided, one for each tool, and the mechanism operating these is geared positively to the turret, so that whichever way the the turret is turned, the right stop for each particular tool is always brought into position. These stops are adjustable, and act as dead stops as well as automatic trips. The feed to the capstan rest is driven from the end of the spindle by a covered train of gear and a three-speed cone pulley, and then through two changes of gear operated by one of the levers under the front of the headstock, thus giving six changes in all. These changes are arranged in a ratio best calculated to meet the different requirements of the work.

The saddle has both automatic sliding, surfacing and screw-cutting motion, and all the feed handles are interlocked, so that when one feed is in action none of the others can be put in without first throwing the other out The top slide is provided with a square turret at the front and a square tool post at the rear. The square tool post has indexing motion, and may be locked independently of this in any desired position.

Both the tool posts may be removed when desired, and form tools or any other necessary adaptation fixed by means of the tee slots. The feed motion for the saddle is driven from the rear of the spindle by the above-mentioned train of gear, and then through a change gear box operated by three levers, giving eight changes of feed and a reversing motion. All these changes and the reversing motion apply to all the three feeds, viz.: sliding, surfacing and screwcutting. Four automatic and dead stops are provided independently for the sliding and surfacing motions. A pump, tank, and fittings are provided for lubricating the work when using steel, and when desired an oil-feed through the turret is supplied.

THE UNDERTYPE ENGINE.

BY J. C. R. ADAMS.

(*Continued from page* 969, Vol. V.)

Previous articles on the subject of Portable Engines will be found in the July, August, September, and October Numbers of PAGE'S MAGAZINE, and in the subsequent numbers of PAGE'S WEEKLY.

MESSRS. DAVEY, PAXMAN AND CO., of Colchester. were very early in the field with their Compound undertype engine, much of the electric light and power supplied to the South Kensington series of Exhibitions, 1883, and onwards, being driven by Messrs. Paxman's engines of this class.

MESSRS. DAVEY, PAXMAN AND CO.'S UNDERTYPE COMPOUND.

Fig. 6 illustrates with sufficient accuracy the design of both the compound and high-pressure automatic classes, the particular engine shown being one of the larger sizes, which from 25 n.h.p. and upwards are made with cast-iron built-up girder beds, below that size being mounted upon a steel channel frame. In general arrangement the engine details are similar to those of the compound portable engines already noticed, and, of course, the same degree of efficiency and economy is obtained from the undertype class.

Horse Power.		Cylinder.		Revs.
Noml.	Effective.	Dia.	Stroke.	per Min.
4	7–10	6¼	12	135
6	12–15	8¼	12	135
8	16-20	9½	12	135
10	20–25	10½	14	120
12	24–30	12	14	120

DOUBLE CYLINDERS.

Noml.	Effective.	Dia.	Stroke.	per Min.
8	14–20	6½	12	135
10	20–25	7¼	12	135
12	24–30	8¼	12	135
14	28–35	8¾	12	135
16	32–40	9½	12	135
20	40–50	10½	14	120
25	50–62	12	14	120
30	60–75	13	16	105

COMPOUND.

Horse Power.		Cylinder.			Revs.	Total Weight.
Noml.	Effective (Economical Load).	H.P.	L.P.	Stroke.	Per Min.	Cwt.
8	22	5½	9	14	155	89
10	27	6½	10½	14	155	108
12	33	7	11¼	14	155	128
16	44	8	13	14	155	176
20	55	9	14½	16	135	203
25	68	10	16	18	120	256
30	82	11	17½	18	120	303
35	96	12	19	24	90	376
40	110	12¾	20	24	90	404

The working pressure of the compound engine is 140 lb., and the cylinder ratio is about 2·6 to 1. The cranks are not balanced, but both central and outside bearings are provided for the crankshaft.

RUSTON'S COMPOUND UNDERTYPE.

Messrs. Ruston, Proctor and Co., Ltd., of Lincoln, also make a speciality of the undertype engine. Fig. 7 illustrates a very fine example, built for the Indian North Western Railway. The wrought-iron girder frame (optional as against the cast-iron bed) is very strongly attached to, and stiffened by, the portion of the cylinder casting projecting downwards, to the planed sides of which the channel girders are bolted. At the other end the massive cast-iron ashpan performs a similar function. A central bearing is provided for the crankshaft, which is a machined steel forging, but not balanced. In the 12-h.p. sizes and upwards a fourth bearing is supplied outside the flywheel. The crosshead slides are cylindrical, with box-pattern crossheads having adjustable slide blocks, and the connecting rods at the crank end are fitted with marine type

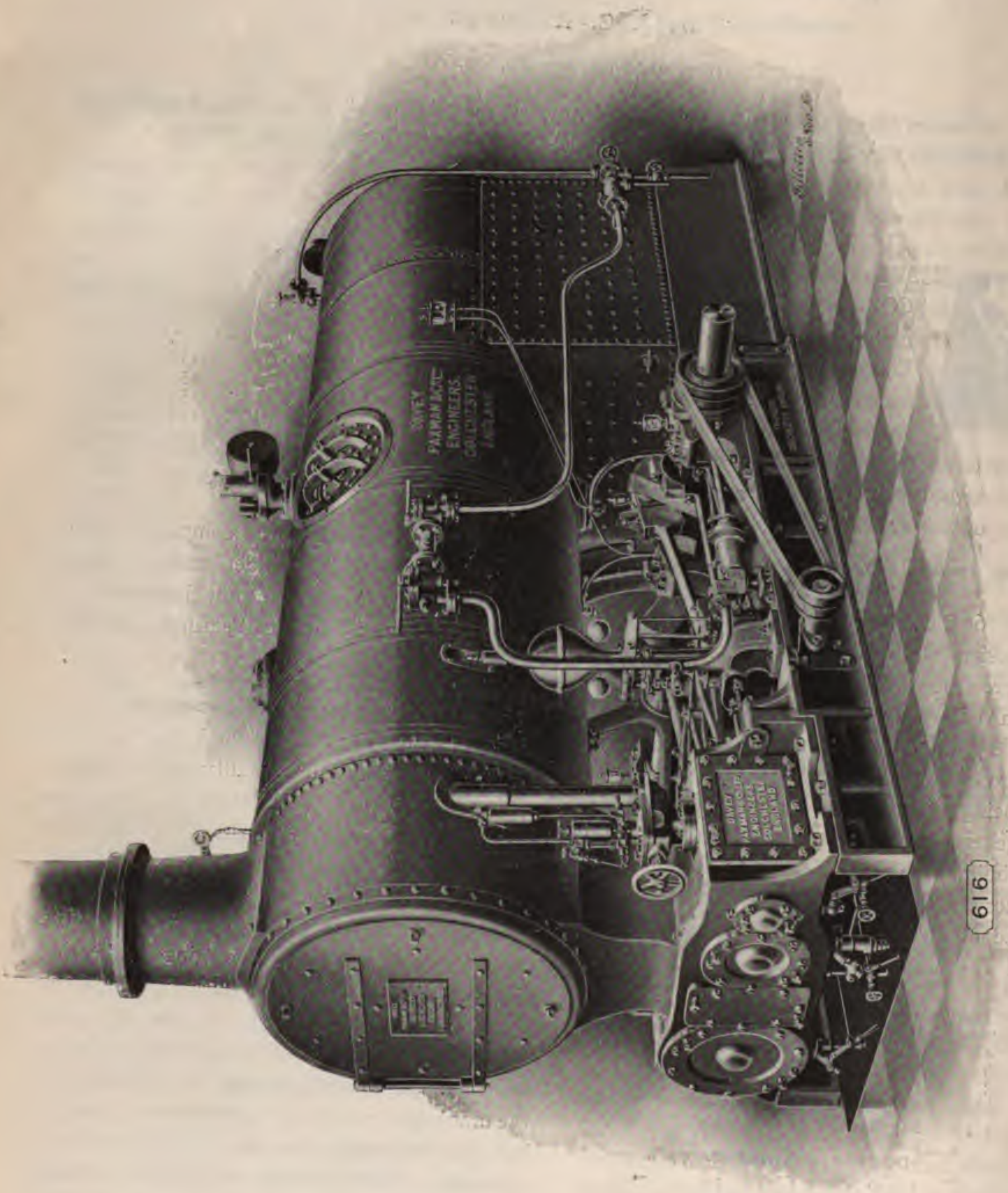


FIG. 6. UNDERTYPE COMPOUND ENGINE BY MESSRS. DAVEY, PAXMAN AND CO., LTD.

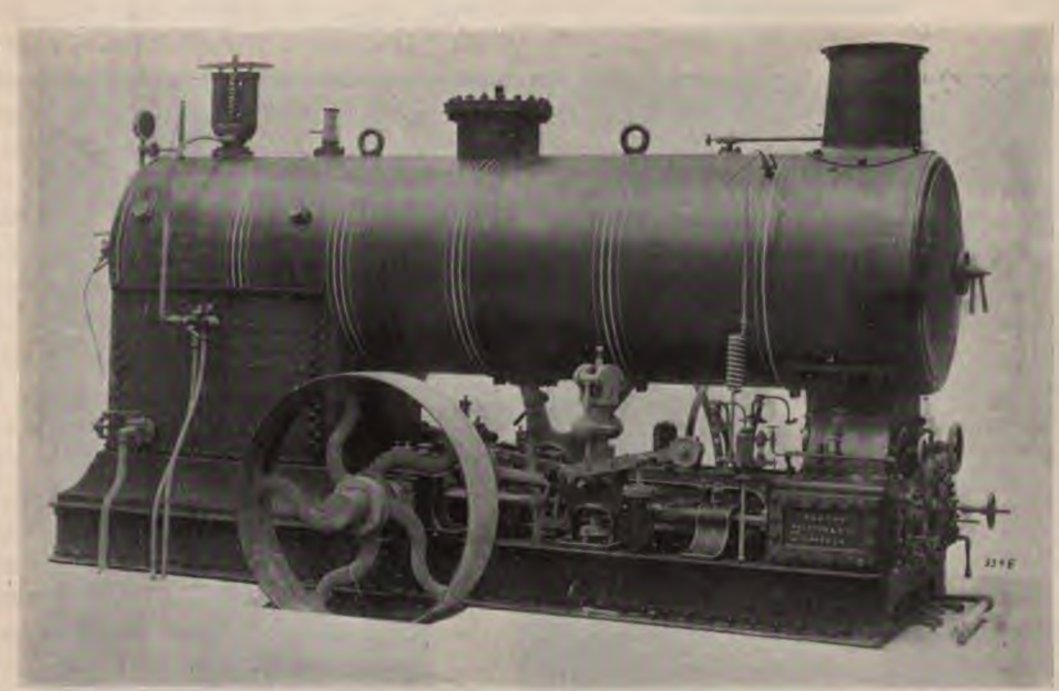


FIG. 7. AN UNDERTYPE ENGINE BUILT BY MESSRS. RUSTON, PROCTOR AND CO., LTD., FOR THE INDIAN NORTH WESTERN RAILWAY.

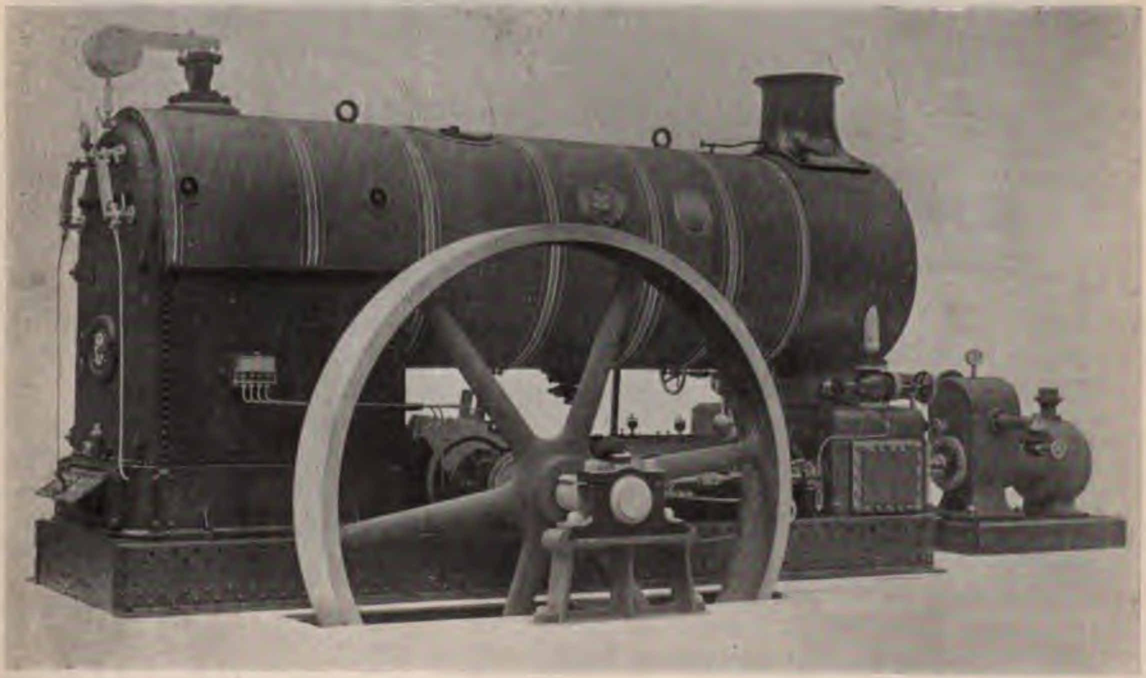


FIG. 8. A SIMILAR ENGINE FITTED WITH CONDENSER.

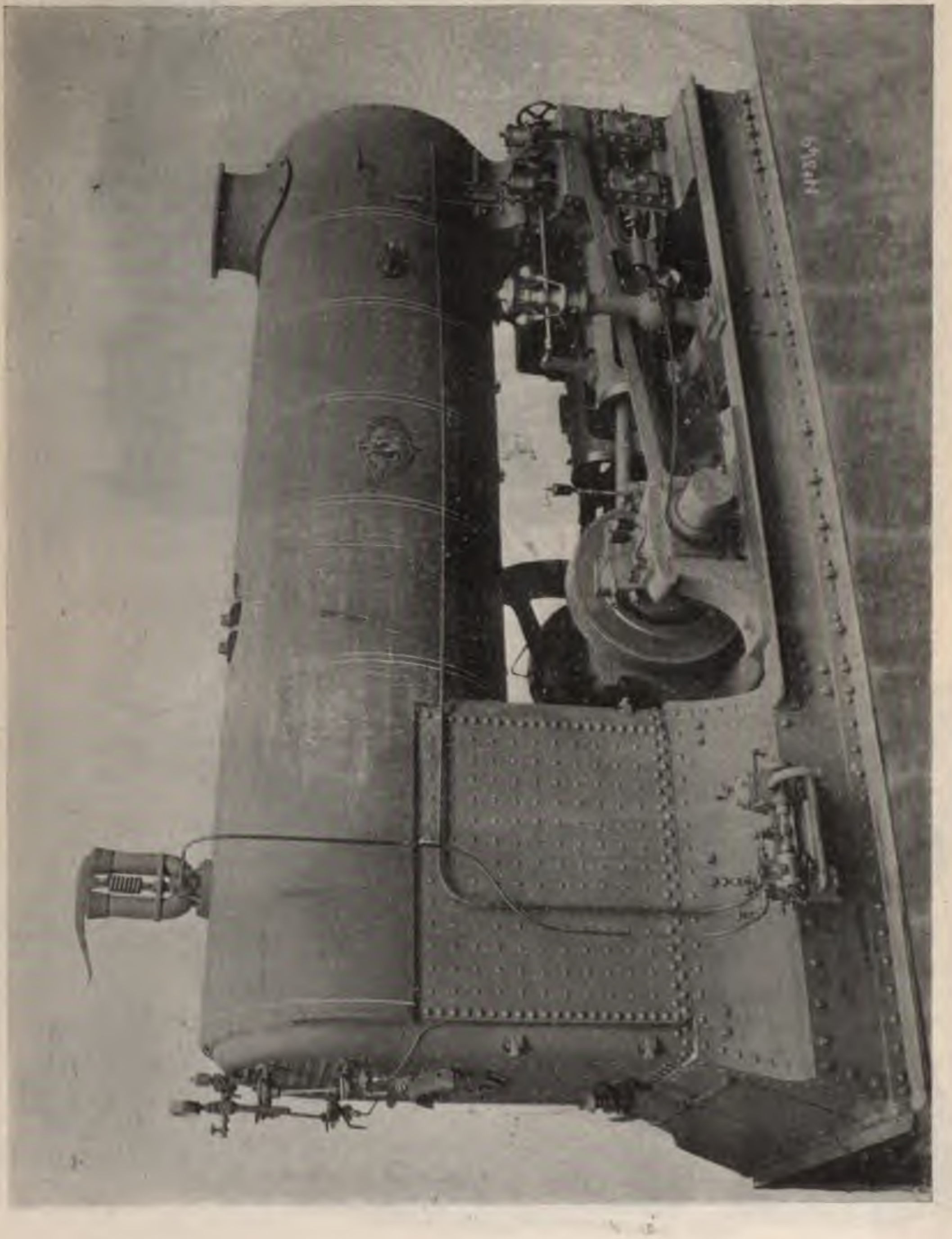


FIG. 10. ONE OF MESSRS. MARSHALL'S LARGER UNDERTYPES, FITTED WITH PROELL EXPANSION GEAR.

brasses. The main bearings are in four parts, with vertical and horizontal adjustments. The automatic expansion gear of the link type, varying the cut-off between the limits of 1 per cent. and 60 per cent., is controlled by a chain-driven governor, fitted with an oil-cylinder or dashpot to ensure steadiness with a sensitive governor. Generally speaking, the equipment of these engines leaves nothing to be desired.

Fig. 8 shows a nearly similar engine, but built to a slightly different specification, and fitted with condenser, the diverting valve hand-wheel for which is seen just under the barrel of the boiler. This engine is fitted with centrifugal oilers to the cranks, and lubricating arrangements for non-stop running, but these, of course, are not part of the regular equipment. Messrs. Ruston manufacture the compound engines in the following sizes, viz. :--

Horse Power.		Cylinders.		Stroke.	Revs.. per Min.	Total Weight. Cwt
Noml.	Effective	H P.	L P			
6	1 -16	5	8	10	200	92
8	18–22	5¾	9	12	180	117
10	24–28	6½	10½	12	180	127
12	30–35	7	11	14	155	150
16	40–48	8	12¾	16	135	190
20	50–60	9	14	16	135	240
25	62–75	10	16	18	120	286
30	75–90	11	17	18	120	340
35	87–105	12	19	20	105	404
40	100–120	13	20½	24	90	484
50	125–150	14	22½	24	90	565

The working pressure is 120 to 140 lb., and the cylinder ratio is 2½ to 1.

The single and double cylinder high-pressure engines are constructed upon the same lines as the compounds, with steel channel frames, or cast-iron bed plates, at the option of the purchaser. They can be fitted with automatic expansion gear, and with condensers when desired.

DIMENSIONS OF SINGLE AND DOUBLE CYLINDER ENGINES.

Horse Power.		Cylinder.		Revs. per Min.	Total Weight. Cwt.
Noml.	Effective.	Dia.	Stroke.		
3	8	6½	10	165	46
4	10	7	12	140	64
5	13	8	12	140	70
6	15	8½	12	140	76
7	18	9¼	12	140	84
8	21	10	12	140	93
10	28	11	14	130	110
12	34	12	15	125	121
DOUBLE CYLINDERS.					
8	20	6¾	11	140	96
10	25	7¾	12	140	113
12	30	8½	12	140	124
14	36	9	14	125	141
16	44	10	14	125	152
18	54	10½	15	120	177
20	60	11	16	120	195
25	70	12	17	110	262
30	80	13	18	105	312

MESSRS. MARSHALL'S (P. 3) UNDERTYPE, 8 TO 35 H.P.

Messrs. Marshall, Sons, and Co., Ltd., of Gainsborough, make their compound undertype engines up to 35 n.h.p., as fig. 9 (page 32), which is taken from a 30 n.h.p. engine. (The waterheater shown, as well as the non-stop lubricating arrangements are, however, not included in the outfit). The boiler is here illustrated uncovered, to show the riveting, but is, of course, in practice, lagged and finished off, as in fig. 10. Fig. 10 is a view of the larger engines (40 to 60 n.h.p.), which are fitted with Proell expansion gear, in place of the Hartnell, used in the smaller sizes.

MESSRS. MARSHALL'S (P. 4) UNDERTYPE 40 TO 60 H.P.

The leading features of Messrs. Marshall's undertype engines generally are steel-girder frames, cylindrical trunk guides, outside steam chests, balanced cranks with centre bearing, and, in the 16-h.p. sizes and upwards, an additional bearing outside the flywheel. The Hartnell governor is a powerful vertical (as distinguished from Messrs. Fowler's, which runs upon a horizontal axis), spring governor with inverted arms, acting upon a radius-road working in a slot link of the usual type, and thus varying the travel of the expansion valve—a flat slide working upon the back of the main valve.

Dr. Proell's gear, as used in the larger sizes (fig. 10) is of a totally different construction. In this system the steam is admitted to each end of the high-pressure cylinder by a double-seated conical lifting valve, worked thus: From an eccentric on the crank-shaft an inclined flat rod leads to a rocking arm, connected by a short shaft on the top of the steam chest to a double-armed lever at right angles to it. The

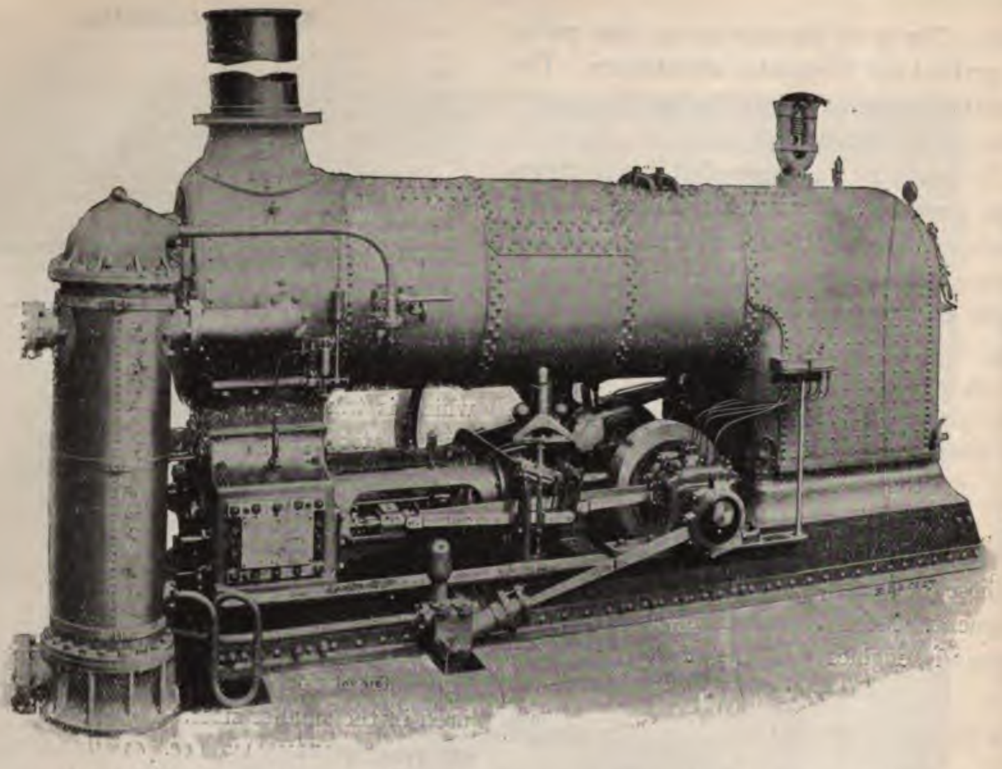


FIG. 9. 30 N.H.P. COMPOUND UNDERTYPE ENGINE BY MESSRS. MARSHALL, SONS AND CO., LTD.

to-and-fro movement of the rocking arm translated into an up-and-down motion of the double-armed lever lifts alternately the steam valves at both ends of the cylinder; and, if it were not for the interference of the governor, would lower each valve on to its seat again as it lifted the other. The governor has the effect of "tripping" or releasing the valves at a point determined by the height of the governor-sleeve, which may be anywhere between 0 and about 60 per cent. of the stroke. The sudden descent of the valves when "tripped" is arrested by the air-valves in the small vertical cylinders, which form a cushion, and let the valve down quietly upon its seats, yet quickly enough to give a sharp and definite cut-off upon the indicator diagrams. The steam, having done its work in the high-pressure cylinder, is exhausted through another set of ports through slide exhaust valves, worked in the usual mannner. These are balanced valves, *i.e.*, relieved of the pressure upon their backs by floating rings in contact with the steam-chest covers. The low-pressure cylinder is fitted with slide valves upon Meyer's system, in which the virtual length of the expansion valve is altered by right and left-handed screw worked by a hand-wheel outside the steam chest, and, consequently, capable of being varied by hand when the engine is running.

Messrs. Marshall's dimensions are as follows: for compound engines at 140 lb. pressure the cylinder ratio averaging 2·56 to 1:—

Horse Power.			Cylinders.			Revs
Noml.	Effective Non-condensing.	Condensing.	Dia. H.P.	Dia. L.P.	Stroke.	per Min.
8	24	30	5½	9	12	180
10	30	39	6½	10½	14	155
12	36	46	7	11¼	14	155
16	48	61	8	12¾	14	155
20	60	76	9	14	16	135
25	75	96	10	16	18	120
30	90	115	11	17½	18	120
35	105	131	11½	18	18	120
40	120	156	13	21	24	90
50	150	191	14	22½	24	90
60	180	230	15½	25	27	80

(*To be continued.*)

QUESTIONS OF THE DAY.

III.—The National Encouragement of the British Inventor: How can it be secured? (*Continued from page* 970.)

WHAT CONSTITUTES A PATENTABLE INVENTION.

On the vexed question as to what should and what should not constitute an invention, we have received an interesting letter from Mr. Henry Davey, of Conaways, Ewell, Surrey, from which we have extracted the following :—

Faraday discovered an electric effect by turning a coil of wire in a magnetic field. It required invention to give practical effect to this discovery. The effect itself was new and any mechanism to give practical effect to it must necessarily be new also.

The dividing line between a mere new combination of parts more or less obvious and a true invention is involved in subtlety. Where the new combination produces a scientific result unthinkable to experts generally, then it is distinctly an invention. The inventor has been more far-seeing than the experts.

Inventions are sometimes made without the aid of scientific teaching and are the result of a logical association of common knowledge in the mind of the inventor. Accurate observation of every-day things combined with logical methods of thought and a true sense of practical requirements are good without scientific attainment, but are better with it.

The invention of the first steam engine, viz., that of Newcomen, was the result of the logical association of common knowledge in the mind of the inventor, guided by a clear insight into what was practically required.

Watt's improvement on the Newcomen engine was not the result of a scientific discovery, but having observed that steam was condensed by cold water and that the steam entering the Newcomen engine cylinder came into contact with cold water, he set himself the problem of causing the steam to enter the cylinder without coming in contact with the condensing water, and that it should only do so on leaving the cylinder after having done its work. In his own words he succeeded by intense thinking. The logical setting of the problem was the first step, then came the inventive genius in arranging a combination of valves, pipes, cylinders and pistons, all separately known in such a way as to secure the desired result in a practically workable form.

When he succeeded he had made no new discovery, but had made an entirely new combination of mechanism, by means of which a result was obtained not obtained before.

It may be asked, is not a new combination, although not securing any new result, an invention? It is, in a restricted sense, and may be an improvement on anything that has been done before, and in that sense, if it is of great commercial or scientific importance, the inventor should be granted protection for his invention.

It is not possible that the Patent Office can determine the value of any proposed patent, but obviously it can help the inventor by giving him a list of patents already granted which appear to be of a similar nature. To refuse an application after that, because of anticipation, would be to pass judgment on patents already granted, and to invest them with a sort of title to validity, a judgment which might, if the refused patent had been granted, be reversed in the Law Courts.

THE CLASSIFICATION AND ANALYSIS OF PATENTS.

The following remarks, anent the subject of sub-division of an invention into several patents and the necessity of a perfect system of classification of patents, appear in the published report of a paper read at the Society of Arts, on December 14th, 1904, by Mr. C. D. Abel.

In the new rules lately issued by the Board of Trade, some general provision has been made in this direction by the statement that "when a specification comprises several distinct matters, they shall not be deemed to constitute one invention by reason only that they are all applicable to or may form parts of an existing machine, apparatus or process," which rule, however, will of course apply generally to all patent applications, and the difficult question will arise as to the proper definition to be put upon the term "one invention."

It would appear that the Comptroller is now going to adopt a definition similar to the German one.

The efficient carrying out of the new system depend probably quite as much upon a proper classification of the inventions as upon the number and quality of the examining staff.

The search as to the novelty of an invention is obviously enormously facilitated, if one has close at hand a complete synopsis of all prior patents in any way relating to the invention in question.

Now the most perfect system of classification in existence is probably that carried out by the United States Patent Office.

In this office, the subjects of invention are divided into 235 classes, and these classes are distributed among 38 examining divisions of the office.

In my opinion, a separate class should be established not merely generally for machine elements, but for every separate machine element, and the specification of every patent relating to machinery should be carefully analysed to see if it contained any new or improved machine element, and in the event of there being such, it or they should be entered into the corresponding class or classes. Every division of the examining staff should then be supplied with a set of these classes for machine elements.

No doubt the carrying out of such an elaborate analysis of all patents—and the before-mentioned required great increase in the examining staff—would entail a very considerably increased expenditure in the Patent Office, to which our Government would no doubt object.

INVENTION THE MAIN-SPRING OF MODERN COMMERCIAL AND INDUSTRIAL ACTIVITY.

Mr. Abel in the paper referred to paid the following eloquent tribute to the importance of invention.

But I say that in view of the great advantages that would be derived therefrom, both by inventors and the public generally, that increased expenditure ought to be insisted upon. There has, in fact, been a great deal too much false economy practised heretofore by the Government in respect of the Patent Office, and this from the simple fact that neither the Government nor the public has ever estimated at its true value the great debt this country owes to inventors and their inventions. The British public accepts, as a matter of course, every new invention that is brought before it. It knows nothing of the toil, the expenditure of capital, the hard brain work to which inventors subject themselves in order to bring those inventions to perfection, and, consequently it does not feel particularly grateful to them.

We delight to honour our great statesmen and warriors, even to the extent of decorating their statues annually, but who dreams of doing honour to our great inventors ? Yet where would the former be without the latter ? Where, I ask, would be the present widespread state of mental culture but for the invention of paper and the printing press ? Where our great maritime commerce and our magnificent colonial possessions across the seas had it not been for the invention of the mariner's compass ? Where, again, would be our great manufacturing industries, and the commercial prosperity arising therefrom, but for the inventions of men such as Watt, Crompton, Arkwright, Stephenson, Huntsman, Whitworth, Fairbairn, Bramah, Bessemer, Siemens, and a host of others ? Here, no doubt, many will say : Granted that these men deserve well of the nation, but they had their reward in the fortunes they made out of their patent rights.

No doubt some of them did so, but also many of them certainly did not ; it is a well-known fact that many notable inventors died in poverty, and that it was only the manufacturers, who afterwards adopted their inventions, who made money by them. And even of those inventors who eventually did reap pecuniary benefit from their inventions, many, in their enthusiastic belief in their inventions, had spent almost their last penny in costly experiments before they attained success.

It is well known that the late Sir Henry Bessemer spent nearly the whole of his capital upon his invention before he was rewarded with success. Again, the late Sir William Siemens himself told me that he had spent over £10,000 upon his regenerative furnace invention before it was commercially successful.

Thus, it is as much the indomitable courage and perseverance of these inventors, as their inventive genius, that should command our admiration and gratitude.

If then we owe so much to inventors, without adequately recognising their merits, let us at any rate do full honour to an institution that may well be considered as the representative of their genius and labours. Let us make the Patent Office as perfect a technical institution as it is possible to be, thoroughly equipped in every respect for carrying out the duties it has to perform.

The German Empire, with its comparatively limited finances, is now spending nearly a million sterling upon a new patent office of palatial proportions ; if we are content to forego such magnificence, let us at any rate not grudge a few thousands for perfecting the administration of our Patent Office. At the present day, considerably over £100,000 surplus income derived from the pockets of inventors flows annually from the Patent Office into the coffers of the Treasury.

The Patent Office instead of being, as it now is, a mere branch of a second-rate Government Department, should be elevated to the position of an independent Government Department, directly responsible to the Cabinet and Parliament, as constituting the worthy representative of one of the main sources of England's greatness and prosperity.

(To be continued.)

THE WEEK AMONG THE TECHNICAL SOCIETIES.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY.

PROPOSED THAMES BARRAGE.

AT a meeting of this Society, held at Caxton Hall, Westminster, yesterday, a paper on this subject by Mr. James Casey was on the agenda, of which the following is an abstract :—

In the author's opinion the scheme offers a solution to the complicated problem of attempting to remove the difficulties and inconveniences attending the navigation of the Thames, owing to the increasing size of steam vessels, and in properly controlling the enormous volume of commerce flowing into and out of the Port.

The tidal portion of the River Thames proper, extending from Gravesend to Teddington, is 33 miles in length in a direct course, but owing to the various bends and windings in the upper and middle reaches, is about 46 miles in length, a difference of 13 miles. The width of the river at Gravesend—and here it is proposed the barrage should be—is about 2,400 ft., with a depth at low water of 45 ft. The width of the river at London Bridge is 650 ft. at low water, with a depth of 10 ft., and the width of the river at Teddington is 250 ft., with a depth at low water of about 6 ft. The average width of the river between Gravesend and Teddington is about one-third of a mile, and the current about four knots, the rise of tide being from 15 ft. to 20 ft. 9 in. at Gravesend, and 17 ft. to 21 ft. at London Bridge. The fall of the river bed from below Teddington is about 1 ft. in the mile, and free of any rapid currents.

It will be interesting, says the author, to note the various limits of navigable depths at low water Spring tides from Gravesend to London Bridge, as the river is at present. From Gravesend to Crayfordness the limit is 26 ft. draft at low water Spring tides, and from Crayfordness to Halfway Reach the limit is 20 ft. From Halfway Reach to Surrey Commercial Docks (eastern end) is 15 ft., and to London Bridge under 10 ft. From this 15 ft. limit the Royal Commission proposed dredging the river to a depth of 30 ft. at low water Spring tides down to Gravesend.

THE GRAVESEND LOCKS.

The proposal for constructing a barrage across the river from Gravesend to Tilbury, of solid concrete with granite facings, provides, says the author, for four locks, two of which are to be 1,000 ft. in length, and two of 800 ft., and 100 ft. and 80 ft. in width respectively, provided with internal steel gates dividing them into lengths of 300 ft. and 700 ft. in the case of the larger locks, and 300 ft. and 500 ft. in the case of the lesser ones. In addition to the outer gates, a number of adjustable steel sluices will also be provided, fitted at the top and bottom of the barrage, and having sufficient area to regulate the flow and necessary scour of the river bottom during ebb tide. In the base of the barrage would be constructed a railway tunnel connecting Kent and Essex with the northern lines, which, from a commercial and strategic point of view, would be most valuable. At present all passengers, goods, and luggage traffic to and from the Continent has to pass through London, there being no alternative route, but if this railway connection were made, the traffic passing between the Continent and the eastern and midland counties and Scotland would pass directly through without change of carriage, or touching London

As to the strategic value of the tunnel railway the author points out that it would be about 12 miles from Woolwich Arsenal on the west side, and 7·5 miles from Chatham, the great naval dockyard on the east side, thus affording direct and speedy means for the prompt shipment of men and material from these respective depots.

Over the barrage it is proposed to have a roadway for vehicular traffic, and the locks would be worked electrically from a dynamo station. A pilot tower, from which the traffic could be regulated, and the locks and movable bridge controlled, also forms part of the scheme.

The number of vessels passing in and out of the Port at Gravesend during the year ending June, 1903, was 49,545, but the number of small craft, barges, tugs, etc., of 45 tons register and less is stated to be about 3,420 per week, or about 20 in the hour. The four proposed locks working 24 hours per day, would be capable of passing 396 ships, and 2,628 barges and small craft in one day. There being a level twice in the 24 hours, and specia provision made for passing in and out by the aid of motor capstans and kindred appliances.

On completion the barrage would hold up a volume of fresh water from Gravesend to Teddington equal to 4,860 million cubic feet. The daily flow over the weir at Teddington, *i.e.*, the average total daily supply of fresh water, exclusive of the water taken by the London Water Companies, amounts to 113,000,000 cubic feet, independent of the additional affluents from the River Lea and Essex streams, of streams on the south bank, and of sewage effluents from Barking and Crossness and storm overflows. Taking everything into consideration the total is 202,000,000 cubic feet, and taking the value of the river at 4,860,000,000 cubic feet, the daily discharge will at least be about one twenty-fourth with a steady downward flow of about a mile to a mile-and-a-half per hour always running seaward.

COST OF CONSTRUCTION.

The cost of construction of the barrage, tunnel and auxiliary works is estimated at £4,100,360, and the time required for completion, three years, so that having regard to the magnitude of the work, the amount is not unreasonable in comparison with the purchase of docks, creating new ones, dredging extending over ten years in the river, at a proposed combined outlay of £37,000,000. In connection with the dredging scheme, it must be borne in mind that there is a probability of the wharves giving way, as recently occurred at Barking, and at the Port of Boulogne. At the latter place the dredging undertaken with the view of enabling the cross Channel steamers from Folkestone to get in at low water has caused several hundred yards of quay to sink some feet, and the masonry to crack through from top to bottom. The French engineers are excavating behind the masonry in the hope of getting a new foundation, but it means great expense.

The possibilities of the barrage as a storage reservoir of fresh water must not be lost sight of. It will contain nearly a year's supply, even at the estimated requirements of 1941, and the fact that the new storage reservoirs constructed at Staines and other places are nearly all by some oversight built outside the line of fortifications for the defence of London, gives additional value to the barrage scheme. It is only during the months of August and September, as a rule, and then for a short period, that the supply, including the water drawn by the companies, is below the 66,000,000 cubic feet passing over the weir daily, but as the Thames and Severn canal has been opened for through traffic recently, after being practically derelict for years, the author points out that it would not be a difficult feat of engineering to tap the Severn River, and thus have an additional supply, that so far as London is concerned would settle the water question without going to Wales or some other source at an estimated cost of £24,000,000 as proposed by the London County Council.

When the river is held up by the barrage, the present unsightly mud banks will be covered, and it will be possible to develop the large areas of sloblands lying idle on both sides of the river below the levels of Trinity highwater mark, between Woolwich and Gravesend. The barrage will prevent flooding from the sea; pumping arrangements are now being installed by the London County Council on both sides of the river, for draining and preventing overflow.

A DEEP WATER CHANNEL TO THE NORE.

Below Gravesend it is necessary that a channel of 30 ft. to 32 ft. in depth at low water Spring tides should be obtained to the Nore. At present vessels drawing from 24 ft. to 25 ft. cannot get to Gravesend through the present channel at low water without running the risk of grounding. Consequently they prefer to anchor and come up with the rising tide. At Gravesend there is 40 ft. to 45 ft. at low water, and at the Ooze deep (to the east of the Nore Lightship) there is 50 ft. at low water. Thus it would not be a difficult matter to secure by mechanical means a through channel waterway. But to place training walls on the north side from Canvey Island would, as suggested by the 1894 commission, be a great mistake, because there exist in this district, within an area of a few miles, some important factors that regulate the ebb and flow of the tides. On the north side there is Canvey Island, with its creeks; on the south side the Isle of Grain, with its creeks, and the mouth of the River Medway. At the Nore the ebb tide coming down from Gravesend is about spent, and the sand and mud in suspension are deposited; the same may be said with regard to the creeks, and finally with regard to the Medway. Thus there is a confluence of tides and cross-currents at the Nore, all enfeebled, and consequently sandbanks occur. In the estuary the entrance to the Swin Channel, too narrow at present, has, owing to its proximity to the shore, the upper current running in an opposite direction to the lower one, so that vessels in ballast using this Channel to and from the north do not answer their helm, and consequently there are more collisions and wrecks in this channel than in all the others. Therefore the Barrow Channel, which is both wide and deep, should be utilised. As to the suggestion that a direct straight channel might be made from the Nore to the Alexandra Channel, it could certainly be done, but, as to maintaining it, the author has great doubts, and therefore agrees that the Edinburgh Channel, although some miles longer, is safer, and not so liable to silt up, being protected from the North Sea by the Long Sand.

The volume of the water in the estuary is computed to be at high Spring tides 70,200,000,000 cubic ft., and at low water 30,500,000,000 cubic ft. What is known as the tidal wave arises from the heaping up of the waters, and as the wave approaches the indented coast line its process is stopped, and the water being confined in the narrow channels fills up the estuaries and creeks, and in those cases the tide is higher than the open seas. In shallow water such as the North Sea and Channel, the tides seldom exceed 15 ft. rise, and 15 ft. Spring tide at the Nore.

THE CHARLES RIVER BARRAGE.

The United States Government have for some years past contemplated putting a barrage across the Charles River at Boston, which river is similar in many respects with the Thames, but not so large in volume. After most searching inquiry from an engineering and sanitary point of view, they have now decided to erect the barrage, and commenced operations in June last. A special report has been published and issued, which will be found most interesting and instructive.

The adoption of the Thames barrage, as a whole, deserves, in the opinion of the author, the most careful and serious consideration of the naval and military authorities.

INSTITUTION OF MECHANICAL ENGINEERS.

IMPACT TESTS.

HEAT TREATMENT EXPERIMENTS WITH CHROME VANADIUM STEEL.

AT the last meeting of the Society there was an interesting discussion on the latter paper, reported in last week's issue, and for the illustrations to which we beg to acknowledge our indebtedness to the Institution of Mechanical Engineers, who lent the original photographs from which the blocks were made.

The discussion was a joint discussion on the two papers, "Impact Tests on the Wrought Steels of Commerce," and "Heat Treatment Experiments with Chrome Vanadium Steel."

Captain Sankey, one of the authors of the latter paper, drew attention to the remarkable properties of chrome vanadium steel, and specially drew attention to the fact that when the material was soaked for three hours at 1,200 deg. Cent., it gave considerably better results than when soaked for twelve hours at the same temperature. Also, in the former case, the structure was not nearly so ruined. Various modifications had been made in Professor Arnold's machine for this case, which modified some of the results. One alteration that had been made was that the stroke had been altered from 1½ in. to 2 in. Although these alterations were only small, he pointed out that the results, in order to be comparable with the rest, must be multiplied by two, thus bringing the value to approximately 1,600.

The President, in thanking the authors, said he had received a letter from Sir William Roscoe, who regretted his inability to be present at the meeting, as it was a subject in which he had been interested for fifty years. It would be remembered that Sir William Roscoe was one of the first—if not the first—to separate vanadium.

Dr. Carpenter pointed out that the National Physical Laboratory determined the recalescence point of this steel by a differential method, and made the average 705 deg. Cent.—1,301 deg. Fah.—with a temperature of maximum intensity of about 740 deg. Cent.—1364 deg. Fah. He thought there might be some doubt as to how these figures were arrived at, and stated that they were obtained from the cooling curve.

THE VALUE OF VANADIUM AND CHROMIUM.

Professor Harbord referred to the method of making tests in bulk for such materials as rails. This was so expensive that it would be infinitely better if some simple means—as in the case of impact tests—could be adopted, but at present the great objection lay in the irregularity of the results. He would like to ask Mr. Seaton if he obtained the same irregularity. The method adopted by Breuil and Volga was then briefly described, which consisted of clamping one end of the test piece firmly in a vice and allowing a weight to drop on the free end. With regard to the question of notching the bars, he pointed out that Breuil and Volga had come to the conclusion that it was better to leave the bar quite plain, with no notch of any description. He asked Mr. Kent-Smith if he could say how much the vanadium and how much the chromium respectively had to do with the properties of this class of steel, as the data, if it could be given, would be very interesting.

Dr. Stanton said that with regard to impact tests he had had samples of steel supplied, and found that one broke after one blow and yet stood a shock of 50 per cent. greater than one that stood forty-three blows. They had been tested under quantities worked out by the "proof resilience" formula, and there was no permanent set. When the load was increased about 25 per cent. greater than that calculated from the equation there was deformation of the bar.

Mr. Blount wanted to know if anything could be added to the methods of testing that could tell us what cause there is for disease in steel. He thought Professor Unwin was wrong in assuming that mild steel was a homogeneous material, and considered it more analogous to a muscle, and both the molar and the micro structure—the latter corresponding to the nerves—must be considered. On the question of standardisation of impact tests he was of opinion that very many more experiments must be made before any definite conclusions were arrived at, as at present our knowledge was not sufficient to justify the standardisation of impact tests.

THE MAITLAND EXPERIMENTS.

The President said he did not think impact had the slightest effect on a piece in breaking, and he did not think that impact on a notched piece would tell anything which could not be better told by steady loading. He then referred to experiments made in 1867 by Col. Maitland to ascertain the effect of sudden loading or shock.

A strong tube was prepared by being accurately bored and furnished in the middle with a radial vent and a radial pressure gauge. Plugs of steel fitting the bore of the tube were screwed on to each end of the specimen. These plugs were fixed in the tube, the annular space around the specimen being filled in some cases with quick-burning powder, and in others with gun-cotton air-spaced. On the charges being exploded through the vent the plugs were driven violently out of the tube in opposite directions, each carrying one half of the specimen. The elongations under these tests varied from 47 per cent. of 62 per cent. The fracture in all cases was silky and fibrous. With the largest charges of gun-cotton tried, giving presumably the most sudden strain, the specimen in several instances broke in two places, the central piece being cigar-shaped. This unexpected result of increased suddenness of strain giving increased elongation was probably due to the metal not having time to settle, as it were, in what spot to break. Under gradual tension the specimen was stretched very locally, and broke at the spot least able to sustain the strain. Under sudden tension the specimen stretched all over the operative part.

The President then referred to diagrams on the walls in illustration of his arguments. In particular, he drew attention to the significance of local extension. Although its importance was not insisted upon in the papers, it was the particular point which marked the difference between materials that would or would not stand nicking.

Whether the stress were by impact or by a steady transverse stress was not of the slightest importance. The material would stand the amount of work which it had in it, if every section of the material were stretched up to the point when the particles would no longer cohere.

STANDARDISATION OF TESTS.

Mr. Seaton, in reply, said that with regard to the President's remarks on notches, he explained that they were introduced to subject the material to similar stresses, were found in everyday use, and what had been said in the paper fully justified their use. He explained that parts were broken by small shocks applied thousands of times, and the shock that broke the piece was nothing like as great as the one that would be required to break the same piece when new with a few strokes. He was in accord with Mr. Longridge and in favour of a circular section. In answer to Professor Harbord about the irregularity of results, they had found very little variation with the same material, although in the case of bright steel rolled shafting there certainly was not the same regularity. There could be no doubt whatever as to the question of standardisation if the tests were to become recognised. One speaker had suggested that if the bar broke with twenty-four blows, it was four times as strong as one broken in six blows, and had asked if this was correct. That was not so; the bar which broke with twenty-four shocks was certainly stronger, but not in the proportion of 4 to 1. As to the method of breaking the bar, they aimed at doing so simply by shock, without introducing bending at all. In conclusion, he wished to thank everyone for the interest they had taken in the paper, and again explained that he did not in any way suggest that their method was the correct one, or the one that was to be followed. They had prepared the paper simply as a means of bringing this subject prominently before the Institution in order that some good might result from the discussion.

TESTS AT THE CRITICAL TEMPERATURE.

Mr. Kent-Smith said he would answer most of the questions in writing. With regard to Dr. Carpenter's remarks on the thermo-electric and differential methods for recalescence determinations, he knew they were both the same, and considered that they ought to have substituted "electric resistance" method, as it was a more suitable term. With regard to the tests at the critical temperature, he would give some interesting results, in the report, that had recently been obtained at temperatures varying from 690 deg. to 720 deg. Dr. Carpenter had only been able to obtain one retardation point, but Mr. Kent-Smith stated that they—the authors—had certainly obtained two. In answer to Professor Harbord as to how much the percentage of vanadium and chromium respectively was responsible for the physical properties of the steel, Mr. Kent-Smith explained that by increasing the amount of the latter, a higher stress was obtained, and with a static stress of 38 tons per square inch, the steel practically keeps the ductility of the raw material.

FARADAY SOCIETY.

The tenth ordinary meeting of the Faraday Society was held on Monday, December 19th, 1904, at the Institution of Electrical Engineers, M. J. Swinburne, vice-president, occupying the chair.

M. Adolphe Minet communicated Part II. of his paper on "The Electric Furnace: Its Origin, Transformations, and Applications."

Dr. F. Mollwo Perkin read a paper by himself and Mr. W. C. Prebble on the "Electrolytic Analysis of Cobalt and Nickel."

Mr. F. Gelstharp presented two short papers entitled "The Electrolytic Preparation of Tin Paste" and "Note on the Electrolytic Recovery of Tin" respectively.

The author first describes briefly the original Indian mode of making tin paste—which is used for the production of metallic paper and other ornamental purposes—and the chemical process as generally carried out. The latter is troublesome on account of fumes, and some of the tin is precipitated as bright crystals, which are useless for this purpose. Moreover, the electrolytic processs is less costly, in spite of the low current efficiency (50 per cent.), and can be worked continuously. The process consists in dissolving anodes of tin, roughly cast from commercial ingots, in dilute hydrochloric acid, and depositing the metal in the form of sponge on cathodes of block tin or tinned iron. The current density of the cothode is 270 amperes per square meter. The electrolyte is kept in a state of rapid circulation. The deposited sponge is allowed to grow to a thickness of about an inch, and is then scraped off the cathodes. It then floats to the top of the bath and is scooped away. To produce 20 cwt. of paste a week requires a generator giving 1,500 amperes at 8 to 10 volts.

ELECTROLYTIC RECOVERY OF TIN.

Mr. Gelstharp's second note describes an experiment that has some bearing on the conditions necessary for electrolytically stripping tin plate. A current was sent through an electrolyte of pure caustic soda at a temperature of 80 deg. C. by means of an anode and cathode of tin plate. The voltage was 3½, but a current of only ⅓ ampere passed through the cell; there was very little gassing and the tin did not strip from the anode, but became coated with a light-brownish adherent deposit. The author considers this to be an oxide of tin, for on reversing the current for an instant and then reversing again, a current of 1½ amperes at 1 volt passed freely, and the tin was effectively dissolved, due to the reduction of the oxide film to metal by the hydrogen evolved at the moment of reversal.

The deposited tin generates hydrogen in water; the author considers that besides containing an alloy of tin and hydrogen, tin paste deposited from an alkali solution also contains sodium.

Agitation of the cathode is of great importance in tin recovery; a quick succession of shocks by reducing polarisation reduces the consumption of energy by 30 to 40 per cent.

Finally, the acid and alkali processes for tin recovery are compared. The former is the more suitable for making tin paste, and the latter for tin recovery from scrap.

INSTITUTE OF MARINE ENGINEERS.

FUEL ECONOMY BY INSULATION.

At a recent ordinary meeting Mr. R. B. Lyddon contributed a paper on this subject, of which the following is an abstract:—

The subject may be divided into three sections, insulations of heat, of cold, and of sound, but the author deals only with the first. The author refers to losses by radiation, which seldom receives the consideration it deserves, and makes comparison between twenty-four different classes of non-conductors. Hair felt, as might be expected, tops the list, but is, of course, open to the objection of being inflammable. Among non-inflammable materials it is well-known that silicate cotton is the best non-conductor, its peculiar value consisting in its capacity to absorb air. Thus, a cubic foot of solid slag, when converted into fibre, increases by twelve times its original bulk, which shows that the original slag has enmeshed a quantity of air equal to eleven times its own bulk.

Silicate cotton is also fireproof and free from smell, no other material approaches it is the union of these qualities with high air content. Silicate cotton is a pliable, soft, and elastic mass, the fibres of which cross and interlace each other in every direction, and the contained air is held "still." Note the distinction between "still" air, which is air held quite motionless, and "confined" air. Confined air, in the sense of shut-up air, has long been thought one of the best non-conductors of heat, but it should be remembered that confined air always circulates in proportion as it has room to move. The larger the air-space the more it moves, the result being poor insulation. If the air-space is microscopic, as in silicate cotton, it cannot move at all, and conducts the least possible heat.

There is another form of non-conducting material, viz., mica, which has lately come into notice. In its natural state it is non-combustible, but not a good non-conductor of heat, and to improve this condition it is treated mechanically—that is, it is corrugated; and the sheets of mica so treated are placed one over the other, with these corrugations at right angles, thus very clearly showing that its efficiency as a non-conductor depends on the imprisoned air in very small sections. To this material there are, points out the author, only two objections: firstly, that it is not such a good non-conductor as silicate cotton, and, secondly, that it is not so easy to manipulate as silicate cotton.

OBITUARY.

Mr. William Henry Baldwin, jun., president of the Long Island Railroad Company since 1896, and one of the best known and ablest railway men in America, died at his country home at Locust Valley, on Tuesday, at the age of 42.

By the death of Mr. James Hall, Tyneside has lost a prominent commercial man. His association with the first screw collier, the *John Bowes*, singles him out for mention in connection with the development of the seaborne coal trade. In partnership with his brother, Mr. Hall owned a modest fleet and was one of the founders of the Newcastle-on-Tyne Iron Steam Ship Freight and Demurrage Association. He always displayed the keenest interest in questions affecting local trade, and was the initiator of the movement for h e adoption of a standard measure of coal. He was a well-known philanthropist, and was one of the founders of the *Wellesley* training ship for boys.

The second son of the late Sir John Fowler, Mr. Percival Fowler, came of a well-known family, to whose distinction he himself, however, added not a little in the department of mining engineering. He was one of the explorers of Dutch Guiana, and played a part in the development of the West Australian goldfields, in addition to engaging in mining work in other parts of the world.

Mr. Richard Charles Else will be remembered among engineers as one of the associates of Brunel, but during recent years he was better known as a prominent Freemason.

Mr. W. G. Laws, whose death is reported from Newcastle, had acted in the capacity of engineer to that city. He had been formerly associated with the North Eastern and North British Railways.

Mr. George James Von Dadelszen lived long enough to be known as one of the fathers of the London metal trade, with which he was connected for upwards of fifty years, and his death breaks more than one old association. The firm of Von Dadelszen and North was famous in the '50's, and had wide ramifications. Mr. Dadelszen engaged in colossal dealings, and in later years he traded alone. He remained a member of the Metal Exchange until a few years ago.

The late Mr. A. A. Rickaby, the founder of the Bloomfield Engine Works, was well-known on Wearside. His name had been associated with some big undertakings connected with marine engineering.

By the death of Mr. George J. Bridge, West Africa has lost a mining engineer who had latterly devoted his great abilities to the development of the gold resources of that country.

The death is announced from New York of Mr. James L. Maclean, formerly assistant secretary of the Caledonian Railway in Glasgow and author of a book entitled "The British Railway System."

Mr. Michael Madden, whose death has just taken place at Southampton, was formerly manager of the Great Northern and Midland Joint Railway.

Mr. Edmund Hunt will be remembered as the first secretary of the Institute of Engineers and Shipbuilders in Scotland. He was an authority on patent law.

The death is reported of Mr. Samuel Jennings, of Sunderland. The deceased was for many years allied with the late Mr. John Crown, the well-known builder of the large clipper ships for which the Wear won a reputation.

Mr. L. J. Morgan, a well-known Welsh mining engineer, died last week, at Aberdare.

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts.

CONTRACTS OPEN.

	Last Day.
Erith.—Four contracts in connection with the Electric Tramways. Particulars of Messrs. Hawtayne and Zeden, 6, Queen Street Place, London, E.C. Tenders to Mr. C. H. Fry, Clerk	Jan. 9
Bradford.—Electric lighting Dudley Hill new schools. Mr. Wilson Bailey, Tanfield Buildings, Market Street	Jan. 9
Newton Abbot. — Construction of a masonry reservoir, to contain 85,000 gallons, and providing and laying 900 ft. of 4-in cast iron mains. Mr. Samuel Segar, Engineer, Union Street, Newton Abbot	Jan. 10
Islington.—Construction of steel water-storage tank to hold 250,000 gallons, and of cast-iron pumping mains at Public Baths, Hornsey Road, Upper Holloway. Borough Engineer, Mr. J. Patten Barber, Town Hall, Upper Street, N.	Jan. 11
Burma Railway.—Bridge work, 150 ft. and 30 ft. spans, pillars, posts, etc., for fencing, eye bolts and strand wire, and Portland cement. Secretary, 76, Gresham House, London, E.C.	Jan. 11 & Jan. 12
Belfast.—Supply and erection at new infectious diseases hospital, of boilers and electric light installations, including engines, dynamos, etc. Mr. Samuel Black, Town Clerk	Jan. 12
Bettws-y-coed.—Construction of waterworks extensions, about seven miles, and an embankment. Mr. E. R. Owen, Union Offices, Llanwrst	Jan. 12
Spain.—Supply of revolving platforms (Contract 1), steel rails (Contract 2), in connection with the improvements at the Port of Valencia. Particulars of the Commercial Intelligence Branch, Board of Trade, 73, Basinghall Street. Tenders to Port Administration, Valencia	Jan. 16 & Jan. 14
London.—Construction, supply, and erection for the South London Electric Supply Corporation at their works, of one 750 kw. steam alternator, etc. Secretary, Bengeworth Road, Loughborough Junction ...	Jan. 16
Dover.—Construction of about 1¼ miles of double line of light railway to River, including the supplying and laying of steel girder rails, etc. Borough Engineer, Maison Dieu House, Dover	Jan. 16
Egremont. — Building two twin-screw saloon steamers for the passenger ferry service on the river Mersey for the Ferries Committee of the Wallasey Urban District Council. Ferries Manager, Egremont Ferry	Jan. 16
Amsterdam.—Supply of cast-iron mains and additional parts for a drinking water conduit to a weight of about 1,176,000 kg. in two lots. Particulars of Wed. P. van Waesberge and Zoon, Houttuin 73, Rotterdam	Jan. 16
Gravesend.—Electric lighting of King Street, National Schools. Mr. C. F. McInnes, Electricity Works	Jan. 16
Rochdale.—Supply of points and crossings for the Corporation. Mr. S. S. Platt, Borough Surveyor, Town Hall	Jan. 16
Ripon.—Retubing condensers for the Corporation. The Gas Manager, Ripon ...	Jan. 18
Newport (Mon.). — Construction and erection of a steel, arched suspension roadway bridge over River Usk at Kemeys. County Surveyor, Newport	Jan. 19
Kidderminster. — Erection of engine house, boiler house, and provision, laying and jointing of 800 yds. 10 in. cast-iron main, in connetion with water supply. Engineers Messrs. Wilcox and Raikes, 63, Temple Row, Birmingham	Jan. 20
London.—The County Council invite tenders for the road-work and plate-laying required for the construction of electric traction on the conduit system for the authorised tramway in Rosebery Avenue. Particulars of Chief Engineer, Spring Gardens, S.W.	Jan. 24
Spain.—The Gaceta de Madrid of December 17th contains a notice calling for tenders for the construction of lighthouses at Cape Lebeche and Tramontona, Balearic Isles, at the upset price of 137,185 pesetas (about £4,033). The estimate, conditions, and plans may be seen in the Ministry of Agriculture, Industry, Commerce, and Public Works, Madrid	Jan. 25
Leicester.—Construction and erection of steel roofs for the engine and boiler houses of the Beaumont Leys effluent pumping station. Mr. Geo. Mawbey, Town Hall, Leicester	Jan. 25
Johannesburg.—Supply of vignoles, rails, fishplates, angle steel guard rails, etc., for Municipal Tramways. Mordey and Dawbarn, 82, Victoria Street, S.W. ...	Jan. 26.
Port Elizabeth.—Supply of materials in connection with Corporation Electricity Supply Works. Section A: Boiler-house plant; Section B: Engine-room plant; Section C: Electricity supply mains; Section D: Accumulators and boosters; Section E: Switchboards and instruments; Section F: Cranes; Section G: Public Lighting; Section H: Meters; Section I: Workshop equipment. Messrs. Davis and Soper, Agents, 54, St. Mary Axe, London, E.C.	Jan. 26

Bootle.—Supply of complete water-softening plant of the continuous operation type at electricity works, Pine Grove; for the Corporation. Borough Electrical Engineer Town Hall ... ... Jan. 14

Drax (Selby).—Schemes and tenders for electric light installation, electric pump, etc. Mr. W. St. G. Drennen, Read's Grammar School, Drax ... ... Jan. 28

Edinburgh.—Supply of gas plant and appliances, including gas exhausters and engines, water-tube condensers, Pelouze and Audouin condensers, etc., for Edinburgh and Leith Corporations. Mr. James McG. Jack, 25, Waterloo Place, Edinburgh Jan. 30

Brisbane. — Supply of 2,000 tons steel rails and 168 tons of steel fishplates. Chief Engineer, Brisbane, or Agent-General, for Queensland, 1, Victoria Street, London, S.W... ... ... Mar. 7

CONTRACTS CLOSED.

Greenock. — Scott's Shipbuilding and Engineering Company have received an order to build a screw steamer of 2,000 tons for the China Navigation Company, Ltd.

Port Glasgow.—D. S. Dunlop and Co. have received a contract for a screw steamer for the Northern Steamship Company, of New Zealand.

Dudley. — James Watt and Co., of Soho Foundry, Birmingham, have received from the South Staffordshire Waterworks Company an order for the engines and pumps for its Pumping Station, Dudley.

Lowestoft.—Contracts for feeder cables have been placed with Callenders Cable and Construction Company Ltd. at £535 per 1,000 yards, and for lighting cables with W. F. Dennis and Co. at £23 per 100 yards.

Paddington.—An order for steam roller and scarifier has been placed with Ruston, Proctor, and Co. at £425 15s. 6d.

Admiralty.—The Lancashire Dynamo and Motor Company, Ltd., have received an order from the Admiralty for the whole of the electrical equipment for Malta Dockyard, including boilers, engines, dynamos, motor generators, and motors, in accordance with the specification of Messrs. Preece and Cardew.

Belfast.—J. J. White and Co., Ltd., have received the order for relaying the tramways. There is a permanent way consisting of 28½ miles of double track. 2 miles of single track, and 8 miles of double track to be repaired. The concrete bed is to be 7 in. thick, and the paving of granite setts. There will be 37 miles of overhead construction, mostly on the span-wire system. In the power-station there are to be three steam dynamos, dlrect current, of 1,000 kilowatts each, running at 180 revolutions per minute. In addition, there are to be two 250-kilowatt and two 125-kilowatt three-phase motor-generators. There is also to be installed a 25-ton crane.

Monte Video.—J. J. White and Co. Ltd., have secured a contract for 51 miles of permanent way, with overhead equipment. The contract exceeds £400,000 in value.

Mansfield. — The Mansfield and District Light Railways contract, to the value of £48,000, has been placed with J. J. White and Co., Ltd.

Kirkby-in-Ashfield.—The contract for the construction of the new gas-works has been placed with R. Dempster and Sons, Ltd., at the price of £13,849.

Leeds.—An order for 850 tons of steel tramway rails has been placed with Walter Scott, Ltd., at £5 7s. 6d. per ton.

COMING CONTRACTS.

Chapel-en-le-Frith.—The Council are about to raise a loan of £21,000 for carrying out a water scheme.

Eastbourne.—An inquiry has been held into the application for sanction to borrow £3,500 for purchasing motor omnibuses and for sewerage works.

North-Western Indian Railway.—A line of about 55 miles is to be constructed by this company, from Shadera to Sangla. Particulars may be obtained from the secretary at Lahore.

Huddersfield.—The Council is about to make electric lighting extensions.

Burnley.—A considerable sum is to be spent on the building and equipment of a new technical school.

Chili.—The Government have now authorised the expenditure of a sum of 4,500,000 piastres on harbour works at Talcahuano.

Penrith.—An inquiry has been held into the Council's application for permission to borrow £6,850 for electric supply purposes.

Pudsey.—The Town Council is about to put up an electric supply station.

St. Pancras.—The L.C.C. has agreed to lend Borough Council £7,515 for electric supply purposes.

Bournemouth.—The Town Council is about to apply for sanction to a loan of £20,000 for the erection of cliff lifts and other improvements.

APPOINTMENTS VACANT.

Last Day.

Huddersfeld. — Assistant lecturer in the department of Civil and Mechanical Engineering. Salary £130. Particulars of Mr. Thomas Thorp, Secretary, Huddersfield Technical College ... ... —

Chelsea. — Lecturer in Mechanical Engineering at the South-Western Polytechnic. Salary £150. Particulars and forms of Secretary ... . Jan. 12

APPOINTMENTS FILLED.

Sunderland.—Mr. L. D. Conesland has been appointed Head of the Civil and Mechanical Engineering Department of the Technical College.

Metropolitan District Railway. — Mr. Joseph Carter has been appointed secretary, in the place of Mr. William Jones, who has retired after a service of forty years.

Glasgow and South-Western Railway.—Mr. John Robinson has been appointed chief goods-manager. Mr. Robinson joined the company as a junior clerk in 1877.

Midland Railway Company. — Mr. Evans, late of the Glasgow and South-Western, has been appointed goods' manager.

Nottingham.—Mr. F. W. Davies has been appointed engineer to the Nottingham Corporation water undertaking.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

The following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares business is being currently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our Share List will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from possible inaccuracies.

STOCK EXCHANGE SETTLING DAYS.—Settling days on the Stock Exchange are as follows :—

Consols: February 1st. General Settlements: January 13th, 27th, February 10th. Bank Rate, April 21st, 3 per cent.

I.—ENGINEERING, IRON, AND STEEL COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
11,270	5	5%	Alldays & Onions Pneumatic Engineering, Ltd.	3	3 — 3¼*
10,000	5	3/-	Do. Cum. Pref. 6 per cent. ..	5	4¼— 4¾
3,210,000	1	2/6	Armstrong (Sir W. G.), Whitworth and Co., Ltd.	1	3 3/16 - 3 5/16
76,970	5	2/-	Do. 4% Cum. Pref.. ..	5	5⅜— 5⅝
1,500,000	100	4%	Do. 4% 1st Mort. Dbs. Rd.	100	100 —102*
£100,000	100	4½%	Aveling and Porter, Ltd., 4½% Reg. Mt. Debs. Red.	100	96 — 99*
530,000	1	1/7⅕	Babcock and Wilcox, Ltd., Ord. ..	1	3 3/16— 3 5/16
100,000	1	7⅕d.	Do. ,, 6% Cum. Pref.	1	1½— 1⅝
20,000	5	3/-	Baker (Joseph) and Sons, Ltd., 6% Cum. Pref...	5	5 — 5½
250,000	1	6⅗d.	Baldwins, Ltd., 5½% Cum. Pref. ..	1	1 — 1⅛
£250,000	Stk	4½%	Do. 1st Mt. 4½% Deb. Stk. Red.	100	99 —101*
150,000	4½	2/8⅖	Barrow Hæmatite Steel Co., Ld., O.	4½	1 5/16 — 1 7/16
50,000	4½	6/-	Do. do. Cum 2nd. Pref.	4½	4¼— 4¾
33,334	5	2/6	Bayliss, Jones and Bayliss, Ltd., 5% Cum. Pref. Shares	5	4¾— 5¼
£500,000	100	—	Beardmore (Wm.) & Co., Ltd., 4½% 1st Mt. Debs., Red., Scrip 50% pd	—	99 —101*
50,000	10	6/-	Bell Brothers, Ltd., 6% Cum. Pref.	10	11¾— 12¼
£366,600	Stk	4%	Do 4% Deb. Stock, Red.	100	98 —100*
149,850	1	6d.	Bengal Iron and Steel Ord... ..	1	1 — 1⅛
200,000	1	1/-	Beyer, Peacock and Co., Ltd., Ord.	1	17/32— 19/32
300,000	1	6⅗d.	Do. 5½% Cum Pref.	1	27/32— 29/32
£300,000	Stk	4½%	Do. 4½% Red. Deb. Stock	100	94 — 97*
1,629,760	1	6d.	Bolckow, Vaughan and Co., Ltd., O. Nos. 1-1,629,760	1	31/32— 1 1/32
1,860,900	1	3⅗d.	Do. Nos. 1,639,101-3,500,000	12/-	17/32— 19/32
1,160,000	1	4½d.	Brown (John) and Co., Lim., Ord., Nos. 1-1,160,000	15/-	1¼— 1⅜
590,000	1	6d.	Do. Ord., Nos. 1,160,001-1,750,000	1	1 11/16—1 13/16
74,000	10	5/-	Do. 5% Cum. Pref.	10	11 —11½
154,500	5	2/6	Cammell, Laird & Co., Ltd., Ord...	5	8 — 8½
232,500	5	2/6	Do. 5% Cum. Pref. ..	5	5⅛— 5¼
450,000	1	1/6	Clayton & Shuttleworth, Ltd., Ord.	1	31/32— 1 1/32
70,000	5	2/6	Do. 5% Cum. Pref.	5	5¼— 5½
£250,000	Stk	4%	Do. 4% 1st Mort. Db. Stk. Red	100	100 —102*
100,000	10	30/-	Consett Iron Co., Ltd., Ord.. ..	7½	31— 33
75,000	1	2/6	Delta Metal, Ltd. Shares	1	1⅞— 2⅛
1,259,594	1	3⅗d.	Dorman, Long & Co., Ltd.	1	⅝— ¾
£400,000	Stk	4%	Do. 4% 1st Mort. Perp. Deb. Stk.	100	90 — 93*
£250,000	Stk	—	Do. 6% 2nd Mort. Deb. Stk , Red.	—	94 — 96*
200,000	5	3/-	Dunderland Iron Ore Co., Ltd., 6% Cum. Pref. and Participating..	5	2¼— 2¾
250,000	1	9⅗d.	Dunlop (James) & Co., Ltd., Ord...	1	9/16— 11/16
300,000	1	7⅕d.	Do. 6% Cum. Pref. ..	1	13/16— 15/16*
4,721	13	12/-	Ebbw Vale Steel, Iron & Coal Co., Ltd.	13	8½— 9½
69,754	13	12/-	Do. do. do.	10	7⅛— 7⅝
20,250	10	8/-	Elliott's Metal, Ltd.	8	5 — 5¼
5,000	10	5/-	Do. Cum. Pref. 5%	10	9 — 9½
186,748	Stk	4%	Do. Deb. 4%	100	95 —100
25,000	10	6/-	Fairfield Shipbuilding & Engng.Co., Ltd., 6% Cum. Pref. ..	10	10¾— 11¼
£250,000	Stk	4½%	Do. 4½% Mort. Deb. Stk. Red.	100	99 —102
126,000	3	3/-	Fraser & Chalmers, Ltd., Ord. ..	3	4¼— 4¾*
21,000	3	1/6	Do. 7½% Cum. Pref.	3	5½— 6*
965,000	1	1/-	Guest, Keen & Nettlefolds, Ltd. Ord.	1	2 3/16— 2 5/16
344,000	5	2/6	Do. 5% Cum. Pref.	5	5⅝— 6⅛
£1,850,500	Stk	4%	Do. 4% Irred. Mort. Deb.Stk	100	103 —105*
13,000	5	2/6	Gwynnes, Ltd., 5% Cum. Pref. ..	5	2½— 3½
250,000	1	1/-	Hadfield's Steel F'dry Co., Ld., Ord.	1	3 — 3⅛
20,000	10	4/6	Do. 4½% Cum. Pref.	10	10½ — 11
30,000	5	3/-	Hall (J. & E.), Ltd. 6% Cum. Pref...	5	5 — 5½
408,505	1	1/6	Harvey United Steel Co., Ltd. ..	1	1 1/16— 1 3/16
28,001	5	7/-	Head, Wrightson & Co., Ltd. ..	5	4½— 5
85,000	1	7⅕d.	Hill (Richard) & Co. (1899) Ld., Ord.	1	⅝— ⅞
18,000	5	3/-	Do. 6% Cum. Pref.	5	4⅜— 4⅞
30,000	10	6/-	Hornsby (Richard) & Sons, Ld., Ord.	8	5¾— 6¼
750,000	1	6d.	Howard & Bullough, Ltd., Ord. ..	1	1¼— 1⅜*
25,000	10	6/-	Do. 6% Pref. (Non-Cum.) ..	10	12½— 13*
£250,000	Stk	4%	Do. 4% Deb. Stk., Red. after 1905	100	94 — 97*
37,500	10	20	Kynoch, Ltd.	10	18 — 18½
49,537	10	5%	Do. Cum. Pref. 5%	10	10⅜—10⅝*
300,000	1	4⅘d	Lambert Bros., Ltd., Ord.	1	⅝— ⅞
50,000	5	2/9	Do. 5½% Cum. Pref... ..	5	4 — 4½*
40,000	3	2/1⅕	Leeds Forge Co., 7% Cum. Pref. ..	3	3¾— 4¼
200,000	1	7⅕d.	Lysaght (John), Ltd., 6% Cum. Pf.	1	1 5/16— 1 7/16
£300,000	Stk	4½%	Do 4½% 1st Mt. Deb. Stk., Red.	100	108 —110*
40,000	10	5/-	Mather & Platt, Ld., 5% Cum. Pref	10	11 — 11½
210,000	1	6d.	Measures Bros., Ltd., Ord.	1	⅝— ¾
75,000	1	6⅗d.	Do. 5½% Cum. Pref.	1	13/16— 15/16
£75,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk.,Red.	100	96 — 99
21,943	5	2/6	Muntz Metal, Ltd.	5	4¾— 5¼
14,248	5	5%	Do. Pref. 5%	5	4⅞— 5⅜
5,000	62½	47/6	Nantyglo and Blaina Iron Works, Ltd., 8% Cum. Pref.	62½	73 — 75
73,000	10	5/-	N. Brit. Loco. Co., Ltd., 5% Cm. Pf.	10	11¾— 12
80,000	5	—	North-Eastern Steel Co., Ltd., Ord.	5	—
£250,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk.,Red.	100	90 — 93*
122,000	5	2/-	Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B"	5	3¾— 4
50,000	5	3/-	Do. 6% Cum. Pref. "A" ..	5	5¾— 6¼
70,000	10	6/-	Pease & Partners, Ltd., Ord. ..	10	9¾— 10¼
£400,000	Stk	4%	Do. 4% Perp. Deb. Stock ..	100	97 —100
20,000	5	3/-	Peebles(Bruce) & Co.,Ld., 6% Cm.P.	5	4¾— 5
230,000	1	—	Projectile Co. (1902), Ltd., Ord. ..	1	⅜— ⅝
126,938	5	2/-	Rhymney Iron Co., Ltd.	5	1⅝— 1⅞
73,062	5	2/-	Do. New	5	1½— 1¾
£330,000	—	5%	Do. 5% Mort. Deb., Red. ..	100	99 —102*
350,000	1	7⅕d.	Richardsons, Westgarth & Co., Ltd., 6% Cum. Pf. ..	1	29/32— 31/32
£350,000	Stk	4½%	Do. 4½% Perp. Deb. Stock ..	100	94 — 96*
35,000	10	12/-	Ruston, Proctor & Co., Ltd... ..	10	9¼— 9¾
275.000	1	6d.	Scott (Walter), Ltd., Ord.	1	13/16— 15/16
300,000	1	7⅕d.	Do. 6% Cum. Pref. ..	1	1— 1⅛
£300,000	Stk	4%	Do. 4% Perp. Deb. Stk.	100	93 — 95*
£115,300	100	5%	Shelton Iron, Steel and Coal Co., Ld. 1st Charge 5% Debs.. Red ..	100	90 — 93*
£97,900	100	6%	Do. 6% 2nd Mort. Debs., Red.	100	91 — 95*
250,000	1	1/-	South Durham Steel & Iron, Ltd.Or.	1	½— ⅝
300,000	1	—	Do. 6%Cum. Pref...	1	⅞— 15/16
£300,000	Stk	4½%	Do. 4½% Per. Deb. Stock	100	85 — 90*
25,000	10	—	Stephenson (Robert) & Co., Ltd., Or.	10	1½— 1¾
25,000	10	5/6	Do. 5½% Cum. Pref. ..	10	3½— 4
£250,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	76 — 78*
85,000	10	9/-	Stewarts & Lloyds, Ltd., Ord. ..	10	17 — 17½
55,000	10	6/-	Do. 6% Cum. Pref.	10	14 — 14½
634,732	1	4.69d.	Swan, Hunter & Wigham-Richardson, Lim. Ord.	1	⅞— 1
538,845	1	6d.	Do. 5% Cum. Pref.	1	⅞— 1
£240,000	Stk	4½%	Do. 4½% 1st Mort.Deb.Stk.Red	100	96 — 99*
300,000	1	6d.	Thames Iron Works, Shipbuilding & Engineering Co.,Ltd.,5% Cum.Pf.	1	½— 9/16
£200,000	100	4%	Do. 4%Irredeem.1stMort.Deb.	100	67 — 71
£160,000	1	7⅕d.	Thornycroft (John I.) & Co., Ltd. 6% Cum. Pref.	1	15/16— 1 1/16
10,000	10	5/-	Tylor (J.) & Sons, Ltd. 5% Cum.Pf.	10	9½— 10*
$508495200	$100	$½	United States Steel Corp. Com.Stk.	$100	31½— 31¾
$360314100	$100	$1¾	Do. 7% Cum. Pref. Stock	$100	96⅛— 96⅜
$162268000	$ 1000	5%	Do. 10-60yr. 5% Skg.Fd.G.Bds.	$1000	95 — 97
3,350,000	1	1/-	Vickers, Sons & Maxim, Ltd. Ord..	1	2 9/16— 2 11/16
750,000	1	6d.	Do. 5% Non-Cum. Pref. ..	1	1⅛— 1¼
£750,000	Stk	5%	Do. 5% Non-Cum. Pref. Stock.	100	111 —114
£1,250,000	Stk	4%	Do. 4% 1st.Mort.Deb.Stk.Red.	100	103 —105
£1,000,000	100	4½%	Do. 4½% 2nd Mort. Debs.,Red.	100	103 —105
225,000	1	1/2⅖	Weardale Steel, Coal & Coke, Ltd., Def. Ord.	1	13/16— 15/16
500,000	1	7⅕d.	Do. 6% Cum. Pref. Ord. ..	1	⅞— 1
£300,000	Stk	4%	Do. 4% Perpetual Deb.Stock	100	85 — 89
7,637	5	2/9	Weldless Steel Tube, Ltd., Cum. Pref. 5½	5	4¾— 4⅞*
300	Stk	4½%	Do. Mort. Deb. 4½%	100	93 — 98
66,666	5	3/.	Willans & Robinson, Ord.	5	1 — 2
66,666	5	3/-	Do. 6% Cum. Pref.	5	2 — 3
£246,641	Stk	4%	Do. 4%1stMort.Deb.Stk.Red	100	74 — 79½
£150,000	Stk	4½%	Yorkshire Iron & Coal Co., Ltd., 4½% 1st Mort. Deb. Stk. Red.	100	80 — 85*

Stocks and Shares marked * are quoted ex-dividend.

—ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed.	Shares.	Last Divi-dend.	Name.	Paid up.	Closing Prices.
70,000	1	6d.	Alliance Elec. Co., Ltd. 5% Cum. Pf.	1	⅝— ⅞
125,000	1	7½d.	Aron Elec. Meter Ltd., 6% Cum. Pf.	1	7/16— 9/16
120,000	1	9⅜d.	Bell's Asbestos Co., Ltd.	1	13/16— 15/16
100,000	5	4/-	British Insulated & Helsby Cables Ltd., Ord. ..	5	5¼— 5¾
100,000	5	3/-	Do. 6% Cum. Pref.	5	5¼— 5¾
£500,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Rd.	100	101 ··104*
£200,000	Stk	4½%	British Thomson-Houston Co., Ltd., 4½% 1st Mort. Deb. Stk. Red. ..	100	101 —103
400,000	5	3/-	British Westinghouse Electric and Manufac. Co., Ltd., 6% Pref. ..	5	2⅝— 2⅞
£616,353	Stk	4%	Do. 4% Mort. Deb. Stk. Red...	100	86 — 88*
105,731	2	2/-	Brush Elec. Enging. Co., Ltd., Ord..	2	⅝— ⅞
150,000	2	2/4½	Do. 6% Pref.	2	1¼— 1½
£125,000	Stk	4½%	Do. 4½% Perp. 1st Deb. Stk...	100	93 — 96
£125,000	Stk	4½%	Do. 4½% Perp. 2nd Deb. Stk.	100	72 — 75*
35,000	5	5/-	Callender's Cable & Constn. Ltd. Ord.	5	9 — 10
40,000	5	2/6	Do. 5 % Cum. Pref.	5	5 — 5½
£200,000	Stk	4½%	Do. 4½% 1st Mort. Deb Stk. Red.	100	103 —105*
85,000	3	1/6	Crompton & Co., Ltd...	3	1¾— 2
£100,000		5%	Do. 5% 1st Mort. Reg. Debs.	100	93 — 98*
52,000	5	10/-	Dick, Kerr & Co., Ltd., Ord. ..	5	8 — 8½
61,000	5	3/-	Do. 6% Cum. Pref.	5	5⅝— 5⅞
£300,000	Stk	4½%	Do. 4½% Deb. Stock, Red. ..	100	105 —107*
233,334		6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	1⅛— 1⅜
£233,334	Stk	4%	Do. 1st Mort. 4% Irre. Deb. Stk.	100	105 —108
99,261	5	1/6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	3	⅝— ⅞
17,139	5	2/6	Do. "A" Shares Nos. 01-017,139	5	1 — 1½
£344,023	Stk	4%	Do. 4% Deb. Stock Red. ..	100	78 — 83*
£100,000	Stk	5%	Do. 5% Second Deb. Stk. Red.	100	79 — 84
112,100	2	1/7½	Electric Construction Co., Ltd. ..	2	1⅛— 1¼
81,890	2	2/9⅗	Do. 7% Cumulative Pref. ..	2	2¼— 2½
£200,000	Stk	4%	Do. 4% Perp. 1st Mt. Deb. Stk.	100	98 —100
10,248	10	7/6	Evered and Co., Ltd...	10	13 — 15
£100,000	Stk	5%	Ferranti, Ltd., 5% 1st Mort. Deb. Stock, Red...	100	90 — 95
£25,000	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9½— 10*
£200,000	Stk	4%	Do. 4% 1st. Mt. Deb. Stk., Red.	100	91 — 96
35,000	5	5/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	10¼— 10¾
35,000	5	2/3	Do. 4½% Cum. Pref... ..	5	5⅛— 5⅜
£50,000	Stk	4½%	Do. 4½% Mt. Deb. Stk. Red.	100	110 —112
50,000	10	5/-	India Rubber, Gutta Percha & Telegraph Works Co., Ltd.,	10	15 — 16*
£300,000	100	4%	Do. 1st Mort. Deb. Red. ..	100	99 —102
7,500	10	—	Parker, Thos., Ltd.	10	6½— 7
37,350	12	12/-	Telegraph Construction and Maintenance Co., Ltd.	12	38 — 40
£150,000	100	4%	Do. 4% Deb. Bonds	100	101½-103½*

III.—ELECTRIC TRACTION.

Present Amount Subscribed.	Shares.	Last Divi-dend.	Name.	Paid up.	Closing Prices.
120,000	5	3/-	Anglo-Argentine Trams Co., Ld., Or.	5	7½— 8
260,007	5	2/6	Do. 5% Cum Pf.	5	5 7/16—5 9/16*
£230,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888 ..	100	140 —143*
20,000	10	6/-	Barcelona Trams Co., Ltd., Ord. ..	10	11¾— 12¼
10,000	10	5/-	Do. 5% Cum Pf. Shares	10	9 -- 10*
£46,300	100	5%	Do. 5% Debs., Red. ..	100	98 --101
£191,326	Stk	4½%	Do. 4½% Red. Deb. Stk.	100	95 —100
75,606	1	—	Bath Elec. Trams. Ld., Pf. Or. ..	1	⅝— ¾
59,394	1	11·49d	Do. 5% Cum. Pf. ..	1	⅞— 1*
75,000	5	—	Brisbane Electric Tram Investment Co., Ltd., Ord... ..	5	1⅝— 2
75,000	5	2/6	Do. 5% Cum. Pf. ..	5	3¾— 4¼
£425,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	94 —98*
£200,000	Stk	6%	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	100 —103
		5%	Pref. Ord. Stock	100	100 —103
7,500	10	5/-	Do. 5% Cum. Perp. Pf. ..	10	10¼— 10¾
£242,800	40	4½%	Do. 4½% 1st Mort. Debs. ..	40	102 ·104%
£220,000	100	4½%	Do. 4½% Vancouver Power Db.	100	98 —101
133,301	10	6/-	Brit. Electric Traction, Ltd., Ord.	10	9½— 10*
156,487	10	6/-	Do. 6% Cum. Pref... ..	10	10¾— 11¼
£1,000,000	Stk	5%	Do. 5% Perp. Deb. Stk. ..	100	118 —120
£250,000	Stk	4½%	Do. 4% 2nd Deb. Stk. Red..	100	96 — 98
100,000	5	1/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	8¾— 8⅞
40,500	5	3/-	Do. "A" 6% Cum Pref. ..	5	5⅝— 5⅞
27,000	5	3/-	Do. "B" do.	5	5⅛— 5⅜
£200,000	Stk	5%	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	94 — 97*

ELECTRIC TRACTION.—*Contd.*

Present Amount Subscribed.	Shares.	Last Divi-dend.	Name.	Paid up.	Closing Prices.
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	98 —101
102,268	5	3/-	Calcutta Tramways Co., Ltd. ..	5	8⅛— 8⅜
£350,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	106 —108*
480,000	1	1/-	Cape Electric Tramways, Ltd. ..	1	1⅛— 1⅜
40,000	5	2/6	City of Birmingham Trams Co., Ltd. 5 % Cum. Pref.	5	4⅞— 5⅛
£300,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	98 —102
155,000	5	4/-	City of Buenos Ayres Trams. Co., Ld.	5	10¼— 10¾
£116,000	Stk	6%	Do. Per. 6% Deb. Stk...	100	140 —145
£120,000	Stk	5%	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	101 —104
60,000	10	6/-	Dublin United Trams. Co. (1896), Ltd., Ord. ..	10	13 — 14
59,987	10	6/-	Do. 6% Pref...	10	15 — 16
80,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	3½— 4
£150,000	Stk	4%	Do. 4% Deb. Stock.. ..	100	88 — 91*
125,000	10	5/-	London United Trams. (1901), Ltd., 5% Cum. Pref.	10	10⅜—10⅝*
£1,031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	101 —103*
£50,000	Stk	5%	Madras Electric Trams (1904), Ltd., 5% Deb. Stock, Red.	100	101 —103
314,016	1	—	Metropolitan Elec. Trams, Ltd., Def.	1	⅜— ½
500,000	1	6d.	Do. 5% Cum. Pref... ..	1	⅞— 1
£350,000	Stk	4½%	Do. 4½% Deb. Stock, Red.	100	102 —104*
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	½— 1½
110,928	8	2/9⅜	North Metropolitan Tramways Co..	8	4¼— 4¾
£150,000	100	3½%	Do. 3½% Mort. Debs.	100	90 — 95*
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red..	100	101 —104*
24,500	10	10/-	Potteries Elec. Traction Co., Ld., Or.	10	8 — 9
24,500	10	5/-	Do. 5% Cum. Pref. ..	10	8½— 9½
£220,000	Stk	4½%	Do. 4½% Deb. Stk., Red.	100	99 —102

IV.—ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed.	Shares.	Last Divi-dend.	Name.	Paid up.	Closing Prices.
7,500	10	16/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. ..	10	12 — 13
7,500	10	4/6	Do. 4½% Cum. Pref. ..	10	9½— 10
7,500	10	6/-	Do. 6% Cum. Second Pf. ..	10	11 — 12
£70,000	Stk	4½%	Do. 4½% Deb. Stock Red ..	100	102 —104*
14,000	5	2/-	Bromley (Kent) Elec. Lt. & Pr. Co. Ld	5	5¼— 5¾
£50,000	Stk	4½%	Do. do. 4½% 1st Deb. Stk. Red.	100	101 —104
27,507	5	4/6	Brompton & Kensington Elec. Supply Co., Ltd. Ord. ..	5	10½— 11
12,493	5	3/6	Do. 7% Cum. Pref. Shares..	5	10¼— 10¾
60,000	5	3/-	Calcutta Elec. Sup. Cor. Ltd., Ord..	5	8⅛— 8⅜
£288,782	Stk	4%	Central Elec. Sup. Co., Ltd., 4% Gua. Deb. Stk. ..	100	104 — 107
70,000	5	4/-	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord... ..	5	8¼— 8¾
10,000	5	—	Do. do. Ord.	5	8 — 8½
80,000	5	2/8	Do. do. 4½% Cum. Pref...	5	5 3/16— 5 5/16
£350,000	Stk	4%	Do. do. 4% Deb. Stk. Red.	100	101 —103
40,000	5	2/8	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	4⅞—5 1/16*
40,000	5	2/3	Do. do. do. (1903) ..	5	4⅞—5 1/16*
44,436	5	2/3	Chelsea Elec. Sply. Co., Ltd., Ord.	5	6⅝— 7
£150,000	Stk	4½%	Do. do. 4½% Deb. Stk., Red	100	107 —109*
70,595	10	5/-	City of London El. Lghtg. Co., Ld., O.	10	10¾— 11¼
40,000	10	6/-	Do. 6% Cum. Pref... ..	10	13¾— 14
£400,000	Stk	5%	Do. 5% Deb. Stk., Red ..	100	121 —125*
£300,000	Stk	4½%	Do. 4½% 2nd Deb. Stk., Red	100	101 —103*
40,000	10	4/-	County of London Elec. Supply Co., Ltd., Ord.	10	9 — 9½
30,000	10	6/-	Do. 6% Cum. Pref.	10	12 — 12½
£400,000	Stk	4½%	Do. 4½% Deb. Stk., Red. ..	100	107 —110*
£250,000	—	4½%	Do. 4½% 2nd Deb. Stk., Prv. Crts. all paid, Red	100	101 —103
70,000	5	4/6	Edmundson's Elec. Cor. Ltd., Ord.	5	6¼— 6¾
70,000	5	3/-	Do. 6% Cum. Pref.	5	6 — 6½
£300,000	Stk	4½%	Do. 4½% 1st Mort. Db. Stk. Reg	100	107 —109
£80,000	Stk	5%	Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. Stk. Red.	100	86 — 91*
10,000	5	2/-	Folkestone Elec. Supply Co., Ld., O.	5	5½— 6
£50,000	Stk.	4½%	Do. 4½% 1st Deb. Stk., Red.	100	102 —105
15,000	10		Havana Electricity Co., Ltd... ..	10	9½—10½
18,000	5	3/6	Hove Elec. Lighting Co., Ltd., Ord.	5	7⅝— 8
£50,000	Stk	4½%	Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock, Red.	100	100—102
150,000			Kalgoorlie Electric Power & Lighting Corp, Ltd., 6% Cum. Pref.	1	9/16— 11/16
21,000		5/-	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord. ..	5	12¼— 13

Stocks and Shares marked * are quoted ex-dividend.

ELECTRIC LIGHTING AND POWER.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£135,000	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	102 —104
111,000	3	—	London Elec. Supply Corp., Ld., Ord.	3	2⅛ — 2⅜
60,000	5	3/-	Do. 6% Pref.	5	5⅝ — 5⅞
£371,895	Stk	4%	Do. 4% 1st Mort. Db. Stk., Red.	100	95 — 97
100,000	10	9/-	Metropolitan Elec. Sup. Co., Ld., Or.	10	17½ — 18
76,121	5	2/3	Do. 4½% Cum. Pref.	5	$5\frac{7}{16}$ — $5\frac{9}{16}$*
220,000	Stk	4½%	Do. 4½% 1st Mort. Db. Sk., Red.	100	110 —115*
250,000	Stk	3½%	Do. 3½% Mort. Deb. Stk., Red.	100	96 — 98*
£250,000	—	4½%	Midland Elec. Corp. for Power Distribution, Ld., 4½% 1st Mort. Deb.	100	92 — 95*
10,852	10	6/-	Notting Hill Elec. Ltg. Co. Ltd. Ord.	10	14½ — 15
£59,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	101 —103
16,500	5	2/6	Oxford Electric Co. Ltd., Ord. ..	5	6⅛ — 6⅜
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	99 —101
£84,700	100	4½%	Royal Elec. Co. (of Montreal) 4½% 20-yr. 1st Mort. Deb	100	100 —102
40,000	5	5/-	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	13¾ — 14¼
20,000	5	3/6	Do. 7% Pref...	5	8½ — 9
£150,000	Stk	3½%	Do. 3½% Deben. Stock, Red	100	98 —100*
12,000	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2¾ — 3¼
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	83 — 87
65,000	5	3/-	South London Elec. Sup. Co., Ltd. O.	5	4⅛ — 4⅜
100,000	1	—	South Metropolitan Elec Light & Power Co., Ltd. Ord.	1	$\frac{13}{16}$ — $\frac{15}{16}$
50,000	1	8⅖d.	Do. 7% Cum. Pref.	1	1⅜ — $1\frac{7}{16}$
£100,000	Stk	4½%	Do. 4½% 1st Deb. Stock Red.	100	107 —110
50,000	5	2/6	Urban Electric Supply Co., Ltd., O.	5	5 — 5⅛
30,000	5	2/6	Do. 5% Cum Pref.	5	$5\frac{1}{16}$ — $5\frac{3}{16}$
£200,000	Stk	—	Do. 4½% 1st Mort. Deb. Stk. Red	100	104 —106
110,000	5	6/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	12¾ — 13¼
28,151	5	2/6	Do. 5% Cum. Pref.	5	6 — 6½*

V.—TELEGRAPH & TELEPHONE COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£34,800	100	4%	African Direct Tel. Co., Ld., 4% Mt. Debs. (Series A), Red.	100	99 —102*
25,000	10	—	Amazon Telegraph Co., Ld... ..	10	1 — 1½
£763,580	Stk	12/6	Anglo-American Tel. Co., Ltd., Ord.	100	57 — 59
£3,118,210	Stk	25/-	Do. 6% Preferred Ordinary	100	103—104
£3,118,210	Stk	2/-	Do. Deferred Ordinary ..	100	13⅜ — 13⅝
44,000	5	4/-	Chili Telephone Co., Ltd.	5	5⅞ — 6⅛
$15,000,000	$100	$2	Commercial Cable Co., Capital Stk.	$100	170 —190
£1,903,856	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	92 — 94*
16,000	10	5/-	Cuba Submarine Tel. Co., Ld., Ord.	10	8¾ — 9¼
6,000	10	10/-	Do. 10% Preference	10	16½ — 17½
6,000	5	2/-	Direct Spanish Telegraph Co., Ord.	5	3⅜ — 3⅝
		5/-	10% Cum. Preference	5	7¾ — 8¼
£30,000	50	4½%	Do. 4½% Debs...	50	100-102%*
60,710	20	3/-	Direct U.S. Cable Co., Ltd... ..	20	10¾ — 11
£85,800	100	4½%	Direct West India Cable Co., Ltd., 4½% Reg. Debs.	100	99 —101*
£300,000	100	4%	East. & S. African, Ld., 4% Mt. Dbs.	100	101 —103
£200,000	25	4%	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)..	25	100-102%
300,000	10	2/6	Eastern Extension, Australasia and China, Ltd...	10	13½ — 14
£602,400	Stk	4%	Do. 4% Mort. Deb. Stk., Perp.	100	106 —108
£4,000,000	Stk	25/-	Eastern Tele. Co., Ltd., Ord. ..	100	135 —138
£2,000,000	Stk	17/6	Do. 3 % Pref.	100	88 — 90
£1,836,814	Stk	4%	Do. 4% Mort. Deb.	100	105 —107
150,000	10	5/-	Great Northern Telegraph Co., Ltd., (of Copenhagen) ..	10	28½ — 29
£58 700	100	4½%	Halifax and Bermudas Cable Co., Ltd., 4½% 1st. Mort. Debs. Red.	100	99 —101*
17,000	25	12/6	Indo-European Tele. Co., Ltd. ..	25	44½ — 46½
72.680	1	7½d.	Monte Video Telephone Co., Ltd., O.	1	$\frac{23}{32}$ — $\frac{25}{32}$
£1,983,333	Stk	6%	National Telephone Co., Ltd., Pref.	100	108½ —109½
£1,966 667	Stk	5%	Do. Deferred	100	102—104
15,000	10	6/-	Do. 6% Cum. 1st Pref. ..	10	13 — 15
15,000	10	6/-	Do. do. 2nd do. ..	10	12 — 13
250,000	5	2/6	Do. 5% Non-Cum. 3rd Pref.	5	$5\frac{5}{16}$ — $5\frac{7}{16}$
£2,000,000	Stk	3½%	Do. 3½% Deb. Stk., Red. ..	100	96 — 98*
£689,593	Stk	4%	Do. 4% do. do. ..	100	101½-103½*
£1,0 0	—	5/9	Do. 4% Prov. Certs. all paid..	—	101½-103½*
179,313	1	7½d.	Oriental Telephone & Elec. Co., Ltd.	1	1 — 1⅛
50,000	1	7⅕d.	Do. 6% Cum. Pref.	1	1⅛ — 1¼
£100,000	100	4%	Pacific & European Tel. 4% Guar. Debs. Red...	100	96 — 99*
11,839	8	4/-	Reuter's Telegram Co., Ltd. ..	8	7 — 7½
53,000	5	3/-	United River Plate Telep. Co., Ltd.	5	6½ — 6¾*
40,000	5	2/6	Do. 5% Cum. Pref.	5	5 — 5¼*
£179,947	Stk	5%	Do. 5% Deb. Stock, Red. ..	100	104—106*
15,609	10	4/-	W. African Telegraph Co., Ltd. ..	10	7¼ — 7¾

TELEGRAPHS AND TELEPHONES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£30,008	2½	—	West Coast of America, Ltd. ..	2½	½ — ⅝
150,000	100	4%	Do. 4% Deb. Guar. by West. Tel.	100	97 — 99*
88,321	10	6d.	W. India & Panama Teleg. Co., Ld., Or.	10	⅝ — ⅞
34,563	10	6/-	Do. 6% Cum. 1st. Pref. ..	10	7⅜ — 7⅝
4,669	10	6/-	Do. 6% Cum. 2nd Pref. ..	10	6¾ — 7¼
£80,000	100	5%	Do. 5% Deb.	100	101 —103*
207,930	10	3/-	Western Telegraph Co., Ltd. ..	10	13½ — 14
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	101 —103
518,945	Stk	4%	Do. 4% Deb. Stock, Red. ..	100	101 —102*

VI.—SHIPPING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
32,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 5½% Cum. Pref.	10	8½ — 9
£325,000	Stk	4½%	Do. 4½% Red. 1st Mort. Deb. Stk.	100	98 —100
£672,900	Stk	4½%	British & African Stm. Nav. (1900) Ltd., 4½% 1st Mort. Deb. Stk.. Red.	100	91 — 93*
40,000	10	5/6	Bucknall Steamship Lines, Ltd., 5½% Cum. Pref.	10	6 — 7
£600,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk.	100	73 — 76*
£750,000	Stk	4½%	Clan Line Steamers, Ltd., 4½% Deb. Stk. Red. ..	100	98 —100*
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000..	20	13 — 13½
40,000	20	8/-	Do. Nos. 60,001-100,000	10	5¾ — 6¼
£461,430	Stk	4½%	Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. ..	100	99 —101
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord...	1	1 — 1⅛
30,000	10	5/-	Do. 5% Cum. Pref.	10	9¾ — 10¼
327,300	100	4½%	Do. 4½% 1st Mort. Debs. Red.	100	105 —107
25,328	7½	4/7	Gen. Steam Navigation Co., Ld., Ord.	7½	4¼ — 4¾
36,758	8	4/9⅗	Do. Non-Cum. 6% Pref... ..	8	7¼ — 7¾
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	95 — 97*
55,000	5	1/3	Houlder Line, Ltd., Ord.	5	3 — 3½
40,000	5	2/9	Do. 5½% Cum. Pref.	5	3¼ — 3¾
£200,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk. Red.	100	83 — 86*
141,500	10	5/-	Leyland (Fredk.), & Co.. (1900), Ltd., 5% Cum. Pref. ..	10	5 — 5½
£1,160,000	Stk	5 %	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. ..	100	126 —129
£1,160,000	Stk	19%	Do. do. Deferred ..	100	214 —217
£800,000	Stk	3½%	Do. do. 3½% Deb. Stock..	100	99 —101
£648,100	Stk	3½%	Do. do. 3½% 2nd Deb. Stk.	100	96 — 98
15,000	100	30/-	Royal Mail Steam Packet Co. Ord..	60	23½ — 24½
89,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref..	5	4¾ — 5¼
89,075	5	2/6	Do. "B" Ord...	5	4 — 4⅛
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord..	10	8 — 8½
24,000	10	4/6	Do. 4½% Cum. Pref... ..	10	9½ — 10*
£1,008,894	Stk	4%	Do. 4% Debenture Stk., Red.	100	98 —100*

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up,	Closing Prices.
60,000	1	9⅜d.	Chadburn's (Ship) Tele. Ltd., Ord...	1	⅞ — 1⅛
£750,000	Stk	5%	General Hydraulic Power Co., Ltd.	100	135 —140
12,500	10	10/-	Oakey (John) and Sons, Ltd., Ord..	10	24 — 26
10,000	10	6/-	Do. do. 6% Cum. Pf.	10	14 — 15
183,538	1	6·3d.	Power Gas Corp., Ltd., Ord., Nos. 66,463-250	15/-	$\frac{5}{16}$ — $\frac{7}{16}$
66,462	1	8·4d.	Do. do. Nos. 1 66,462	1	$\frac{9}{16}$ — $\frac{11}{16}$
135,000	1	6d.	Waygood (R.) & Co., Ltd., Ord. ..	1	1⅛ — 1¼
135,000	1	7⅕d.	Do. 6% Cum. Pref. ...	1	1⅛ — 1¼

RAILWAY CARRIAGE & WAGON COMPANIES.

Present Amount Subscribed,	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices
10,000	10	7/6	Birm. Railway-Car. & Wagon, L., 1-10,000	10	21 — 21½
8,739	10	3/-	Do. Second Issue 1-8,739....	4	8 — 8½
10,000	10	6/-	Do. Cum. Pref. 6% 1-10,000..	10	13 — 13½
30,111	7	7/-	Gloucester Rail.-Car & Wagon, Ld., A, 1-29,861 & 49,751-50,000	7	8¾ — 9
44,889	7	3/6	Do. B, 29,862-49,750, 50,001-75,000	7	4 — 4½
784,808	1	9d.	Metropolitan Amalgamated Rail.-Carriage & Wagon, Ld., 1-784,808	1	39/- — 40/-
164,288	1	6d.	Do. Cum. A Pref. 5% 1-164,288	1	23/3—24/3
235,000	1	7⅕d.	Do. Cum. B Pref. 6% 1-235,000	1	27/6—28/6
20,000	20	20/-	Midland Rail.-Car. & Wagon, Ld., 1-20,000	10	18¾ — 19¼
10,000	20	7⅕d.	Do. Pref. 6 per cent. 1-10,000		22/3 — 22/9

Stocks and Shares marked * are quoted ex-dividend.

—ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
70,000	1	6d.	Alliance Elec. Co., Ltd. 5%, Cum. Pf.	1	⅝ — ⅞
125,000	1	7½d.	Aron Elec. Meter Ltd., 6%, Cum. Pf.	1	7/16 — 9/16
120,000	1	9½d.	Bell's Asbestos Co., Ltd.	1	13/16 — 15/16
100,000	5	4/-	British Insulated & Helsby Cables Ltd., Ord. ..	5	5¼ — 5¾
100,000	5	3/-	Do. 6%, Cum. Pref.	5	5¼ — 5¾
£500,000	Stk	4½%	Do. 4½%, 1st Mort. Deb. Stk. Rd.	100	101 — 104*
£200,000	Stk	4½%	British Thomson-Houston Co., Ltd., 4½%, 1st Mort. Deb. Stk. Red...	100	101 — 103
400,000	5	3/-	British Westinghouse Electric and Manufac. Co., Ltd., 5%, Pref...	5	2⅝ — 2⅞
£616,268	Stk	4%	Do. 4%, Mort. Deb. Stk. Red...	100	86 — 88*
165,731	2	2/-	Brush Elec. Enging. Co., Ltd., Ord..	2	⅝ — ⅞
160,000	2	2/4½	Do. 6%, Pref.	2	1¼ — 1½
£125,000	Stk	4½%	Do. 4½%, Perp. 1st Deb. Stk...	100	93 — 96
£125,000	Stk	4½%	Do. 4½%, Perp. 2nd Deb. Stk.	100	72 — 75*
35,000	5	5/-	Callender's Cable & Constn. Ltd. Ord.	5	9 — 10
40,000	5	2/6	Do. 5%, Cum. Pref.	5	5 — 5½
£200,000	Stk	4½%	Do. 4½%, 1st Mort. Deb Stk. Red.	100	103 — 105*
56,000	3	1/6	Crompton & Co., Ltd...	3	1¾ — 2
£100,000		5%	Do. 5%, 1st Mort. Reg. Debs.	100	93 — 98*
60,000	5	10/-	Dick, Kerr & Co., Ltd., Ord. ..	5	8 — 8½
61,000	5	3/-	Do. 6%, Cum. Pref.	5	5⅜ — 5⅝
£300,000	Stk	4½%	Do. 4½%, Deb. Stock, Red. ..	100	105 — 107*
233,384	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	1⅛ — 1⅜
£233,384	Stk	4%	Do. 1st Mort. 4% free Deb. Stk.	100	105 — 108
99,261	3	1/6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	3	⅝ — ⅞
17,139	5	2/6	Do. "A" Shares Nos. 01-017,139	5	1 — 1½
£344,068	Stk	4%	Do. 4%, Deb. Stock Red. ..	100	78 — 83*
£100,000	Stk	5%	Do. 5%, Second Deb. Stk. Red.	100	79 — 84
112,100	2	1/7½	Electric Construction Co., Ltd. ..	2	1⅛ — 1⅜
31,300	2	2/9½	Do. 7%, Cumulative Pref. ..	2	2¼ — 2½
£200,000	Stk	4%	Do. 4%, Perp. 1st Mt. Deb. Stk.	100	98 — 100
10,246	10	7/6	Evered and Co., Ltd...	10	13 — 15
£100,000	Stk	5%	Ferranti, Ltd., 5% 1st Mort. Deb. Stock, Red...	100	90 — 95
[illegible]	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9½ — 10*
£200,000	Stk	4%	Do. 4% 1st. Mt. Deb. Stk., Red.	100	91 — 96
36,000	5	5/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	10¼ — 10¾
[illegible]	5	2/3	Do. 4½% Cum. Pref... ..	5	5⅛ — 5⅜
£60,000	Stk	4½%	Do. 4½% Mt. Deb. Stk. Red.	100	110 — 112
80,000	10	6/-	India Rubber, Gutta Percha & Telegraph Works Co., Ltd.,	10	15 — 16*
£300,000	100	4%	Do. 1st Mort. Deb. Red. ..	100	99 — 102
7,600	10		Parker, Thos., Ltd.	10	6½ — 7
37,350	12	12/-	Telegraph Construction and Maintenance Co., Ltd.	12	38 — 40
£150,000	100	4%	Do. 4% Deb. Bonds	100	101½ — 103½*

III.—ELECTRIC TRACTION.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
120,000	5	3/-	Anglo-Argentine Trams Co., Ld., Or.	5	7¾ — 8
200,007	5	2/6	Do. 5% Cum Pf.	5	5 7/16 — 5 9/16*
£330,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888 ..	100	140 — 143*
30,000	10	6/-	Barcelona Trams Co., Ltd., Ord. ..	10	11¾ — 12¼
10,000	10	5/-	Do. 5% Cum Pf. Shares	10	9 — 10*
£46,800	100	5%	Do. 5% Debs., Red. ..	100	98 — 101
£101,846	Stk	4½%	Do. 4½% Red. Deb. Stk.	100	95 — 100
75,606	1		Bath Elec. Trams. Ld., Pf. Or. ..	1	⅝ — ¾
59,894	1	11·49d	Do. 5% Cum. Pf. ..	1	⅞ — 1*
75,000	5	--	Brisbane Electric Tram Investment Co., Ltd., Ord... ..	5	1¾ — 2
75,000	5	2/6	Do. 5% Cum. Pf. ..	5	3¾ — 4¼
£125,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	94 — 96*
£300,000	Stk	6%	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	100 — 103
		5%	Pref. Ord. Stock	100	100 — 103
7,500	10	5/-	Do. 5% Cum. Perp. Pf. ..	10	10¼ — 10¾
£242,800	40	4½%	Do. 4½% 1st Mort. Debs. ..	40	102 — 104%
£300,000	100	4½%	Do. 4½% Vancouver Power Db.	100	98 — 101
188,801	10	6/-	Brit. Electric Traction, Ltd., Ord.	10	9½ — 10*
156,487	10	6/-	Do. 6% Cum. Pref... ..	10	10¾ — 11¼
£1,000,000	Stk	5%	Do. 5% Perp. Deb. Stk. ..	100	118 — 120
£350,000	Stk	4½%	Do. 4% 2nd Deb. Stk. Red..	100	96 — 98
100,000	5	1/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	3⅜ — 3⅞
40,500	5	3/-	Do. "A" 6% Cum Pref. ..	5	5⅜ — 5⅝
37,000	5	3/-	Do. "B" do.	5	5⅛ — 5⅜
£300,000	Stk	5%	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	94 — 97*

ELECTRIC TRACTION.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	98 — 101
102,268	5	8/-	Calcutta Tramways Co., Ltd. ..	5	8⅛ — 8⅜
£350,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	106 — 108*
480,000	1	1/-	Cape Electric Tramways, Ltd. ..	1	1¼ — 1⅜
40,000	5	2/6	City of Birmingham Trams Co., Ltd. 5% Cum. Pref.	5	4⅞ — 5⅛
£300,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	98 — 102
155,000	5	4/-	City of Buenos Ayres Trams. Co., Ld.	5	10¼ — 10¾
£116,000	Stk	6%	Do. Per. 6% Deb. Stk...	100	140 — 145
£120,000	Stk	5%	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	101 — 104
60,000	10	6/-	Dublin United Trams. Co. (1896), Ltd., Ord. ..	10	13 — 14
59,987	10	6/-	Do. 6% Pref...	10	15 — 16
80,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	3½ — 4
£150,000	Stk	4%	Do. 4% Deb. Stock.. ..	100	88 — 91*
125,000	10	5/-	London United Trams. (1901), Ltd., 5% Cum. Pref.	10	10⅜ — 10⅝*
£1,031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	101 — 103
£50,000	Stk	5%	Madras Electric Trams (1904), Ltd., 5% Deb. Stock, Red.	100	101 — 103
314,016	1	—	Metropolitan Elec. Trams, Ltd., Def.	1	⅜ — ½
500,000	1	6d.	Do. 5% Cum. Pref... ..	1	⅞ — 1
£850,000	Stk	4½%	Do. 4½% Deb. Stock, Red.	100	102 — 104*
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	1 — 1½
110,928	8	2/9⅜	North Metropolitan Tramways Co..	8	4¼ — 4¾
£150,000	100	3½%	Do. 3½% Mort. Debs.	100	90 — 95*
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red..	100	101 — 104*
24,500	10	10/-	Potteries Elec. Traction Co., Ld., Or.	10	8 — 9
24,500	10	5/-	Do. 5% Cum. Pref. ..	10	8½ — 9½
£220,000	Stk	4½%	Do. 4½% Deb. Stk., Red.	100	99 — 102

IV.—ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
7,500	10	16/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. ..	10	12 — 13
7,500	10	4/6	Do. 4½% Cum. Pref. ..	10	9½ — 10
7,500	10	6/-	Do. 6% Cum. Second Pf. ..	10	11 — 12
£70,000	Stk	4½%	Do. 4½% Deb. Stock Red ..	100	102 — 104*
14,000	5	2/-	Bromley (Kent) Elec. Lt. & Pr. Co. Ld	5	5¼ — 5¾
£50,000	Stk	4½%	Do. do. 4½% 1st Deb. Stk. Red.	100	101 — 104
27,507	5	4/6	Brompton & Kensington Elec. Supply Co., Ltd. Ord. ..	5	10½ — 11
12,493	5	3/6	Do. 7% Cum. Pref. Shares..	5	10¼ — 10¾
60,000	5	3/-	Calcutta Elec. Sup. Cor. Ltd., Ord..	5	8⅛ — 8⅜
£288,782	Stk	4%	Central Elec. Sup. Co., Ltd., 4% Gua. Deb. Stk. ..	100	104 — 107
70,000	5	4/-	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord... ..	5	8¼ — 8¾
10,000	5	—	Do. do. Ord.	5	8 — 8½
80,000	5	2/8	Do. do. 4½% Cum. Pref...	5	5 9/16 — 5 11/16
£350,000	Stk	4%	Do. do. 4% Deb. Stk. Red.	100	101 — 103
40,000	5	2/8	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	4⅞ — 5 3/16
40,000	5	2/3	Do. do. do. (1903) ..	5	4⅞ — 5 1/16
44,436	5	2/3	Chelsea Elec. Sply. Co., Ltd., Ord.	5	6⅝ — 7
£150,000	Stk	4½%	Do. do. 4½% Deb. Stk., Red	100	107 — 109*
70,595	10	5/-	City of London El. Lghtg. Co., Ld., O.	10	10¾ — 11¼
40,000	10	6/-	Do. 6% Cum. Pref... ..	10	13⅝ — 14
£400,000	Stk	5%	Do. 5% Deb. Stk., Red ..	100	121 — 125
£300,000	Stk	4½%	Do. 4½% 2nd Deb. Stk., Red	100	101 — 103
40,000	10	4/-	County of London Elec. Supply Co., Ltd., Ord.	10	9 — 9½
80,000	10	6/-	Do. 6% Cum. Pref.	10	12 — 12½
£400,000	Stk	4½%	Do. 4½% Deb. Stk., Red. ..	100	107 — 110*
£250,000	—	4½%	Do. 4½% 2nd Deb. Stk., Prv. Crts. all paid, Red	100	101 — 103
70,000	5	4/6	Edmundson's Elec. Cor. Ltd., Ord.	5	6½ — 6¾
70,000	5	3/-	Do. 6% Cum. Pref.	5	6 — 6½
£300,000	Stk	4½%	Do. 4½% 1st Mort. Db. Stk. Reg	100	107 — 109
£30,000	Stk	5%	Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. Stk. Red.	100	86 — 91*
10,000	5	2/-	Folkestone Elec. Supply Co., Ld., O.	5	5½ — 6
£50,000	Stk.	4½%	Do. 4½% 1st Deb. Stk., Red.	100	102 — 105
15,000	10	—	Havana Electricity Co., Ltd... ..	10	9½ — 10½
13,000	5	3/6	Hove Elec. Lighting Co., Ltd., Ord.	5	7½ — 8
£50,000	Stk	4½%	Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock, Red.	100	100 — 102
150,000	1	—	Kalgoorlie Electric Power & Lighting Corp, Ltd., 6% Cum. Pref.	1	9/16 — 11/16
21,000	5	5/-	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord. ..	5	12½ — 13

Stocks and Shares marked * are quoted ex-dividend.

ELECTRIC LIGHTING AND POWER.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£135,000	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	102 —104
111,000	8	—	London Elec. Supply Corp., Ld., Ord.	8	2⅛— 2⅜
60,000	5	3/-	Do. 6% Pref.	5	5⅝— 5⅞
£371,895	Stk	4%	Do. 4% 1st Mort. Db. Stk., Red.	100	95 — 97
100,000	10	9/-	Metropolitan Elec. Sup. Co., Ld., Or.	10	17½— 18
76,121	5	2/3	Do. 4½% Cum. Pref.	5	5 7/16—5 9/16*
220,000	Stk	4½%	Do. 4½% 1st Mort. Db. Sk., Red.	100	110 —115*
250,000	Stk	3½%	Do. 3½% Mort. Deb. Stk., Red.	100	96 — 98*
£250,000	—	4½%	Midland Elec. Corp. for Power Distribution, Ld., 4½% 1st Mort. Deb.	100	92 — 95*
10,852	10	6/-	Notting Hill Elec. Ltg. Co. Ltd. Ord.	10	14½— 15
£59,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	101 —103
16,500	5	2/6	Oxford Electric Co. Ltd., Ord. ..	5	6⅛— 6⅜
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	99 —101
£84,700	100	4½%	Royal Elec. Co. (of Montreal) 4½% 20-yr. 1st Mort. Deb	100	100 —102
40,000	5	5/-	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	13¾— 14¼
20,000	5	3/6	Do. 7% Pref...	5	8½— 9
£150,000	Stk	3½%	Do. 3½% Deben. Stock, Red	100	98 —100*
12,000	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2¾— 3¼
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	83 — 87
65,000	5	3/-	South London Elec. Sup. Co., Ltd. O.	5	4⅛— 4⅜
100,000	1	—	South Metropolitan Elec Light & Power Co., Ltd. Ord.	1	13/16 — 15/16
50,000	1	8⅖d.	Do. 7% Cum. Pref.	1	1⅜— 1 7/16
£100,000	Stk	4½%	Do. 4½% 1st Deb. Stock Red.	100	107 —110
50,000	5	2/6	Urban Electric Supply Co., Ltd., O.	5	5 — 5⅛
30,000	5	2/6	Do. 5% Cum Pref.	5	5 1/16—5 3/16
£200,000	Stk	—	Do. 4½% 1st Mort. Deb. Stk. Red	100	104 —106
110,000	5	6/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	12¾— 13¼
28,151	5	2/6	Do. 5% Cum. Pref.	5	6 — 6½*

V.—TELEGRAPH & TELEPHONE COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£34,800	100	4%	African Direct Tel. Co., Ld., 4% Mt. Debs. (Series A), Red.	100	99 —102*
25,000	10	—	Amazon Telegraph Co., Ld... ..	10	1 — 1½
£763,580	Stk	12/6	Anglo-American Tel. Co., Ltd., Ord.	100	57 — 59
£3,118,210	Stk	25/-	Do. 6% Preferred Ordinary	100	103—104
£3,118,210	Stk	2/-	Do. Deferred Ordinary ..	100	13⅜— 13⅝
44,000	5	4/-	Chili Telephone Co., Ltd.	5	5⅞— 6⅛
$15,000,000	$100	$2	Commercial Cable Co., Capital Stk.	$100	170 —190
£1,903,856	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	92 — 94*
16,000	10	5/-	Cuba Submarine Tel. Co., Ld., Ord.	10	8¾— 9¼
6,000	10	10/-	Do. 10% Preference	10	16½— 17½
6,000	5	2/-	Direct Spanish Telegraph Co., Ord.	5	3⅜— 3⅝
		5/-	10% Cum. Preference	5	7¾— 8¼
£30,000	50	4½%	Do. 4½% Debs...	50	100-102%*
60,710	20	3/-	Direct U.S. Cable Co., Ltd... ..	20	10¾— 11
£85,800	100	4½%	Direct West India Cable Co., Ltd., 4½% Reg. Debs.	100	99 —101*
£300,000	100	4%	East. & S. African, Ld., 4% Mt. Dbs.	100	101 —103
£300,000	25	4%	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)..	25	100-102%
300,000	10	2/6	Eastern Extension, Australasia and China, Ltd...	10	13½— 14
£602,400	Stk	4%	Do. 4% Mort. Deb. Stk., Perp.	100	106 —108
£4,000,000	Stk	25/-	Eastern Tele. Co., Ltd., Ord. ..	100	135 —138
£2,000,000	Stk	17/6	Do. 3 % Pref.	100	88 — 90
£1,836,814	Stk	4%	Do. 4% Mort. Deb.	100	105 —107
150,000	10	5/-	Great Northern Telegraph Co., Ltd., (of Copenhagen) ..	10	28½— 29
£58 700	100	4½%	Halifax and Bermudas Cable Co., Ltd., 4½% 1st. Mort. Debs. Red.	100	99 —101*
17,000	25	12/6	Indo-European Tele. Co., Ltd. ..	25	44½— 46½
72,680	1	7½d.	Monte Video Telephone Co., Ltd., O.	1	23/32— 25/32
£1,983,333	Stk	6%	National Telephone Co., Ltd., Pref.	100	108½—109½
£1,966 667	Stk	5%	Do. Deferred	100	102—104
15,000	10	6/-	Do. 6% Cum. 1st Pref. ..	10	13 — 15
15,000	10	6/-	Do. do. 2nd do. ..	10	12 — 13
250,000	5	2/6	Do. 5% Non-Cum. 3rd Pref.	5	5 5/16— 5 7/16
£2,000,000	Stk	3½%	Do. 3½% Deb. Stk., Red. ..	100	96 — 98*
£689,593	Stk	4%	Do. 4% do. do. ..	100	101½-103½*
£1,0 0	—	5/9	Do. 4% Prov. Certs. all paid..	—	101½-103½*
179,318	1	7½d.	Oriental Telephone & Elec. Co., Ltd.	1	1 — 1⅛
50,000	1	7½d.	Do. 6% Cum. Pref.	1	1⅛— 1¼
£100,000	100	4%	Pacific & European Tel. 4% Guar. Debs. Red...	100	96 — 99*
11,839	8	4/-	Reuter's Telegram Co., Ltd. ..	8	7 — 7½
53,000	5	3/-	United River Plate Telep. Co., Ltd.	5	6½— 6¾*
40,000	5	2/6	Do. 5% Cum. Pref.	5	5 — 5¼*
£179,947	Stk	5%	Do. 5% Deb. Stock, Red. ..	100	104—106*
15,609	10	4/-	W. African Telegraph Co., Ltd. ..	10	7¼— 7¾

TELEGRAPHS AND TELEPHONES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£30,008	2½	—	West Coast of America, Ltd. ..	2½	½— ⅝
150,000	100	4%	Do. 4% Deb. Guar. by West. Tel.	100	97 — 99*
88,321	10	6d.	W. India & Panama Teleg. Co., Ld., Or.	10	⅝— ¾
84,563	10	6/-	Do. 6% Cum. 1st. Pref. ..	10	7⅜— 7⅝
4,669	10	6/-	Do. 6% Cum. 2nd Pref. ..	10	6¾— 7¼
£80,000	100	5%	Do. 5% Deb.	100	101 —103*
207,930	10	3/-	Western Telegraph Co., Ltd. ..	10	13½— 14
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	101 —103
518,945	Stk	4%	Do. 4% Deb. Stock, Red. ..	100	101 —102*

VI.—SHIPPING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
32,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 5½% Cum. Pref.	10	8½— 9
£325,000	Stk	4½%	Do. 4½% Red. 1st Mort. Deb. Stk.	100	98 —100
£672,900	Stk	4½%	British & African Stm. Nav. (1900) Ltd., 4½% 1st Mort. Deb. Stk.. Red.	100	91 — 93*
40,000	10	5/6	Bucknall Steamship Lines, Ltd., 5½% Cum. Pref.	10	6 — 7
£600,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk.	100	73 — 76*
£750,000	Stk	4½%	Clan Line Steamers, Ltd., 4½% Deb. Stk. Red. ..	100	98 —100*
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000..	20	13 — 13½
40,000	20	8/-	Do. Nos. 60,001-100,000	10	5¾— 6¼
£461,430	Stk	4½%	Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. ..	100	99 —101
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord...	1	1 — 1⅛
30,000	10	5/-	Do. 5% Cum. Pref.	10	9¾— 10¼
327,300	100	4½%	Do. 4½% 1st Mort. Debs. Red.	100	105 —107
25,328	7½	4/7	Gen. Steam Navigation Co., Ld., Ord.	7½	4¼— 4¾
36,758	8	4/9⅗	Do. Non-Cum. 6% Pref.	8	7¼— 7¾
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	95 — 97*
55,000	5	1/3	Houlder Line, Ltd., Ord.	5	8 — 8½
40,000	5	2/9	Do. 5½% Cum. Pref.	5	8¼— 8¾
£200,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk. Red.	100	83 — 86*
141,500	10	5/-	Leyland (Fredk.), & Co.. (1900), Ltd., 5% Cum. Pref. ..	10	5 — 5½
£1,160,000	Stk	5 %	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. ..	100	126 —129
£1,160,000	Stk	19%	Do. do. Deferred ..	100	214 —217
£800,000	Stk	3½%	Do. do. 3½% Deb. Stock..	100	99 —101
£648,100	Stk	3½%	Do. do. 3½% 2nd Deb. Stk.	100	96 — 98
15,000	100	30/-	Royal Mail Steam Packet Co. Ord..	60	23½— 24½
39,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref..	5	4¾— 5¼
39,075	5	2/6	Do. "B" Ord...	5	4 — 4½
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord..	10	8 — 8½
24,000	10	4/6	Do. 4½% Cum. Pref... ..	10	9½— 10*
£1,008,894	Stk	4%	Do. 4% Debenture Stk., Red.	100	98 —100*

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up,	Closing Prices.
60,000	1	9⅗d.	Chadburn's (Ship) Tele. Ltd., Ord...	1	⅞— 1⅛
£750,000	Stk	5%	General Hydraulic Power Co., Ltd.	100	135 —140
12,500	10	10/-	Oakey (John) and Sons, Ltd., Ord..	10	24 — 26
10,000	10	6/-	Do. do. 6% Cum. Pf.	10	14 — 15
183,538	1	6·3d.	Power Gas Corp., Ltd., Ord., Nos. 66,463-250	15/-	5/16— 7/16
66,462	1	8·4d.	Do. do. Nos. 1 66,462	1	9/16— 11/16
135,000	1	6d.	Waygood (R.) & Co., Ltd., Ord. ..	1	1⅛— 1¼
135,000	1	7⅕d.	Do. 6% Cum. Pref. ...	1	1⅛— 1¼

RAILWAY CARRIAGE & WAGON COMPANIES.

Present Amount Subscribed,	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices
10,000	10	7/6	Birm. Railway-Car. & Wagon, L., 1-10,000	10	21 — 21½
8,739	10	3/-	Do. Second Issue 1-8,739....	4	8 — 8½
10,000	10	6/-	Do. Cum. Pref. 6% 1-10,000..	10	13 — 13½
30,111	7	7/-	Gloucester Rail.-Car & Wagon, Ld., A, 1-29,861 & 49,751-50,000	7	8¾— 9
44,889	7	3/6	Do. B, 29,862-49,750, 50,001-75,000	7	4 — 4½
784,808	1	9d.	Metropolitan Amalgamated Rail.-Carriage & Wagon, Ld., 1-784,808	1	39/- — 40/-
164,288	1	6d.	Do. Cum. A Pref. 5% 1-164,288	1	23/3—24/3
235,000	1	7⅕d.	Do. Cum. B Pref. 6% 1-235,000	1	27/6—28/6
20,000	20	20/-	Midland Rail.-Car. & Wagon, Ld., 1-20,000	10	18¾—19¼
10,000	20	7⅕d.	Do. Pref. 6 per cent. 1-10,000		22/3— 22/9

Stocks and Shares marked * are quoted ex-dividend.

	£	s.	d.
Angles—Phœnix	6	5	0
,, Best	6	15	
,, Extra Best	7	5	0
Gas Tube Hoops—Phœnix Best	6	15	0
Plates—Phœnix	—		
,, Best Boiler	7	10	0
,, Best Best Boiler	8	0	0
,, Extra Best Boiler	9	0	0
Boiler Tube Strips—Phœnix Best Best	8	0	0

All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly.

Messrs. R. Feldtmann and Co., of Glasgow, quote (Commission extra).

Pig Iron:

	No. 1. £	s.	d.	No. 3. £	s.	d.
Coltness, f.a.s. Glasgow	3	4	0	2	14	6
Gartsherrie ,,	2	18	6	2	14	0
Summerlee ,,	2	18	6	2	13	6
Carnbroe ,,	2	15	0	2	12	0
Langloan ,,	3	4	0	2	14	0
Calder ,,	2	18	6	2	13	6
Clyde ,,	2	18	0	2	13	6
Glengarnock, f.o.b. Ardrossan	2	18	0	2	12	6
Eglinton ,, ,,	2	13	6	2	11	0
Dalmellington, ,, Ayr	2	14	0	2	11	0
Shotts ,, Leith	2	18	6	2	13	6

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, **at works:—**

	£	s.	d.
W.W. ♛ Bars	6	7	6
W.W. Best Bars	6	17	6
W.W. Best Best	7	7	6
W.W. Best Best Best	7	17	6
W.W. Best Shoe	6	17	6
Thornaby ♛	7	17	6
Thornaby Best	8	7	6
Thornaby Best Best	9	7	6
Whitwell Special Admiralty Cable	10	0	0
Special Chain Iron	9	0	0
Tube and Nail Strips	6	10	0
W.W. ♛ Angle Iron	6	10	0
W.W. Best Angle Iron	7	0	0
Tee Iron, to 8-inches United	7	7	6

Terms, Cash, less 2½ per cent. discount on 10th of month ollowing delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington, quote:—

	Iron. £	s	d.	Steel. £	s.	d.
Crown (BNF) Bars	6	10	0	7	0	0
,, ,, Angles	7	0	0	7	10	0
,, ,, Tees	7	10	0	8	0	0
,, (WIW) Hoops	7	0	0	7	10	0
,, ,, Sheets	7	10	0	8	0	0

Ordinary Sizes, F.A.S. Liverpool in 10-ton Lots.
Extras for Sizes and Cutting as per List.

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

Black Sheets:	Singles 20 G 96in. by 36in. per ton. £	s.	d.	Doubles 21 G to 24 G 96in. by 36in. per ton. £	s.	d.
"Vale"	10	0	0	10	10	0
"Shield"	10	10	0	11	10	0
"Severn"	11	10	0	12	10	0
"Baldwin Wilden B."	12	10	0	13	10	0
Charcoal	16	10	0	17	10	0
Best Charcoal	18	10	0	19	10	0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:	£	s.	d.	£	s.	d.
No. 3 Lead	13	10	0	14	10	0
S.V. Lead	15	0	0	16	0	0
No. 3 Terne	15	0	0	16	0	0
S.V. Terne	16	10	0	17	10	0

Tinned Sheets:	Singles 20 G to 108 by 36in. per ton. £	s.	d.	Doubles 21 to 24 G to 96 by 36in per ton. £	s.	d.
Best Coke (Finish)	28	0	0	29	10	0
,, Charcoal (Finish)	30	0	0	31	10	0
Extra ,, ,,	32	0	0	33	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.

Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box.

Extreme sizes in Tin and Patent Coated specially quoted for.

Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.

At works less 2½% for cash monthly, 10th inst.

Galvanized Corrugated Sheets:

	£	s.	d.	
"Phœnix" Brand, 24 G., f.o.b. London, in Bundles	11	15	0	per ton.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	14	7	6	,,

Galvanized Working Up-Sheets:

	£	s.	d.	
24 G., f.o.b. London, in Bundles	13	15	0	per ton.

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£	s.	d.	
Crown Bars	6	10	0	per ton.
Best Bars (1 to 6in. wide, above ¼ in. thick, ½ in. to 4 rounds and squares)	7	0	0	,,
Angles	6	15	0	,,
,, Best	7	5	0	,,
T's	7	0	0	,,
,, Best	7	10	0	,,
Best Shoe Iron	8	0	0	,,
,, Rivet Iron	8	0	0	,,
,, Best Rivet (Special)	9	5	0	,,
,, Cable	9	5	0	,,
,, Screwing	8	5	0	,,

	£	s.	d.	
Best Turning	8	0	0	per ton.
,, Plating	8	5	0	,,
,, ,, Best Best	9	5	0	,,
,, ,, Treble	10	5	0	,,
Plates	7	10	0	,,
Best Plates	8	0	0	,,
,, Boiler Plates	8	10	0	,,
,, Best Boiler Plates	9	10	0	,,
Treble Best Boiler Plates	12	0	0	,,

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon., quote "Star" brand patent wrought nails, steel nails, &c.

Discounts—

45 per cent. off 1-inch to 3-inch strong rose and all fine rose and 6dy. and 8dy. pound.

40 per cent. off 3½ inch to 7-inch strong rose and 10dy. and 20dy. pound.

40 per cent. off all sharp-pointed nails.

Delivered in lots of 2 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis:—

2 tons 9/3 per cwt. }
Under 2 tons 9/6 per cwt. } d/d any Railway Station.

Steel cut nails, 3-inch basis—

2 tons 8/- per cwt. }
Under 2 tons 8/3 per cwt. } d/d any Railway Station.

Slit rods (iron) £7 10s. per ton, at works for 2-ton lots.

Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E.C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla, quote:—

Coke Tin-plates.	Per Box. f.o.b. Wales. £	s.	d.
C 18¾ by 14 124s. 110 lb. "BV"	0	13	0
C 20 by 10 225s. 155 ,, "Jumbo"	0	18	3
C 20 by 14 112s. 108 ,, "Lydbrook"	0	12	6
C 28 by 20 112s. 216 ,, "Lydbrook"	1	5	3

Charcoal Tinplates:

	£	s.	d.
C 20 by 14 112s. 108 lb. "Allaway"	0	13	3

BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes:—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

Steel:	£	s.	d	
Blooms	at 3	12	0	per ton.
Billets	at 3	14	0	,,
Sheet Bars	at 3	16	0	,,

Finished Steel:

	£	s.	d.	
Bars	at 4	16	0	per ton.
Angles	at 4	17	0	,,
Tees	at 4	19	0	,,
Joists	at 4	7	6	,,
Fencing Standards	at 4	19	0	,,
Shoeing Bars	at 5	2	0	,,
Tyre Bars	at 5	4	0	,,
Half-Round Bars	at 5	5	0	,,
Heavy Rails	at 4	10	0	,,
Light Rails	at 4	16	0	,,

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote:—

TIN.

Tin:	£	s.	d.		£	s.	d.	
English Ingots, f.o.b. Dis. 1¼% & 1%	132	10	0	to	133	0	0	per ton.
English Bars, f.o.b. Dis. 1½% & 1%	133	10	0	to	134	0	0	,,
Straits G.M.B., cash Warehouse, Net	132	0	0	to	132	5	0	,,
Straits G.M.B., 3 months, Warehouse, Net	131	10	0	to	131	15	0	,,
Australian, Mr. Bischoff, Warehouse, Net	132	5	0	to	132	15	0	,,

COPPER.

Copper:	£	s.	d.		£	s.	d.	
Standard G.M.B., cash Warehouse, Net	68	12	6	to	68	15	0	per ton.
Standard G.M.B., 3 months, Warehouse, Net	69	0	0	to	69	2	6	,,
English, Tough, Cake & Ingot, Warehouses, Net, Dis. 2½%	71	5	0	to	71	15	0	,,
English, Best Select, Warehouse Net, Dis. 2½%	72	10	0	to	73	0	0	,,
English, Sheets and Sheathing, f.o.b., Dis. 2½%	79	0	0	to	79	10	0	,,
English, Sheets for India, f.o.b., Dis. 2½%	76	0	0	to	76	10	0	,,
Electro, Warehouse, Net	70	0	0	to	70	10	0	,,
Ore, ex. ship, Net	0	11	9	to	0	12	9	per unit.
Regulus, Matte and Precipitate, ex. ship, Net	0	13	0	to	0	13	6	,,

YELLOW METAL.

Yellow Metal:	£	s.	d.	£	s.	d.	
Sheets, 4 by 4 feet for India f.o.b. Dis. 2½%				0	0	6¾	per lb.
Sheathing ,, ,,				0	0	6⅞	,,

SPELTER.

	£	s.	d.		£	s.	d.	
Silesian outports, Net	25	5	0	to	25	10	0	per ton.
Blende of 50% Net	7	0	0	to	7	10	0	,,
Calamine, Net	7	2	6	to	7	12	6	,,

LEAD.

	£	s.	d.		£	s.	d.	
English Pig, Warehouse, Dis. 2½%	13	5	0	to	13	7	6	per ton.
Spanish, ex ship, Dis. 2½%	13	0	0	to	13	2	6	,,
Lead Ore of 70%, Net	6	11	0	to	6	15	0	,,

ANTIMONY.

	£	s.	d.		£	s.	d.	
Star Regulus, f.o.b, Dis. 2½%	37	10	0	to	38	0	0	per ton.
Ore, 50%, ex ship, Dis. 2½%	8	10	0	to	9	0	0	,,
Crude, ex ship, Dis. 2½%	14	0	0	to	15	0	0	,,

QUICKSILVER.

	£	s.	d.	
Spanish, 75 lb., Warehouse, Net	7	15	0	per flask.
Italian ,, ,, ,,	7	14	0	,,

COAL.

LEICESTERSHIRE.

The Nailstone Colliery Company, Leicester, quote. Price per Ton at Pit of 20 Cwt., with ½ Cwt. per Ton for wastage:—

Upper Main Seam.	s.	d.
Main Coal	7	6
Best Hard Steam (hand picked, as used by the Railway Companies)	6	0
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)	6	0
Fine Slack	0	6

Terms, net cash on 10th of month following delivery.

DERBYSHIRE.

The Manners Colliery Co., Ltd., of Ilkeston quote as follows, per ton at pit:

Kilburn Coal:	s.	d.
Best London Brights	9	9
Large Nuts (1½ to 3¼)	9	6
Small Nuts (¾ to 1½)	6	0
Rough Brights	6	0
Peas (⅜ to ¾)	5	0
Slack	3	6
Smudge	2	0

Low Main (or Tupton) Coal:	s.	d.
Low Main Brights	7	6
,, ,, Nuts	7	3
Hards (Good Steam Coal)	8	0
Bakers' Nuts (1" to 2")	6	6
Slack	3	6

The Clay Cross Company's Collieries, Clay Cross, near Chesterfield, quote:—

	per ton at pit. s.	d.
Best Main Coal	10	6
Best Silkstone	10	0
Best House Coal	8	6
Best House Nuts	8	0
Treble Screened Cobbles	7	9
Best Cobbles	7	3

NOTTINGHAMSHIRE.

The Digby Colliery Co., Ltd., near Nottingham, quote per ton at pit:—

Digby Coal:

STEAM.	s.	d.
Best Hand Picked Hard	9	0
Steam Hard	7	9
Hard Nuts	7	0

Gedling Colliery.

HIGH HAZEL.		
London Brights, 4 to 8 in. cube	12	0
Large Nuts, 2 to 4 in. cube	9	6
Small Nuts, ¾ to 2 in. cube	5	6

STEAM.—TOP HARD.		
Best Hard	9	0
Hard Steam	8	0
Cobbles	7	0

CHEMICALS AND OILS.

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square, Manchester, quote:

	£	s.	d.	
Acids: Oxalic	0	0	2⅛	per lb.
Picric, Crystals	0	0	11	,,
Tartaric .... at Manchester	0	0	10⅞	,,

	£	s.	d.	
Acetate of Lime: Brown at Manchester net	8	5	0	per ton.
Grey ,,	11	0	0	,,
Alumina: Alum, Lump, loose	5	5	0	,,
,, ,, in casks	5	7	6	,,
,, Ground, in bags	5	15	0	,,
Sulphate of Alumina, 14%	4	10	0	,,
Ammonia: Carbonate	0	0	3⅝	per lb.
Muriate Grey f.o.b. Liverpool	24	0	0	per ton.
Sal-ammoniac, Lump, 1sts, del$^{d.}$ U.K.	42	0	0	,,
,, ,, 2nds, ,,	40	0	0	,,
Sulphate .... f.o.b. Liverpool	12	15	0	,,
Arsenic: Best White Powdered ....net	12	0	0	,,
Bleaching Powder, 35% .... ,,	4	2	6	,,
Borax: British Refined Crystal........ ,,	12	0	0	,,

Coal Tar Products:					
Benzole, 50/90 %	,,	0	0	8	per gal.
,, 90%	,,	0	0	9½	,,
Carbolic Acid Crystals, 34/35° C. ...	,,	0	0	6⅞	per lb.
,, ,, ,, 39/40° C. ...	,,	0	0	7⅛	,,
,, ,, Liquid, 97/99 % ...	,,	0	0	9	per gal.
,, ,, Crude, 62½% at 60° F. f.o.b.	,,	0	2	2	,,
Creosote, ordinary good liquid......	,,	0	0	1¼	,,
Naphtha, Crude, 20 % at 120° C....	,,	0	0	8	,,
,, Solvent, 90% at 160° C.f.o.b	,,	0	0	8½	,,
,, ,, 95 % at 160° C. ,,	,,	0	0	9½	,,
,, ,, 90 % at 190° C. ,,	,,	0	0	10½	,,
,, Rectified, flash point over 73° F. ....f.o.b.	,,	0	0	11	,,
,, Rectified, flash point over 100° F. ....f.o.b.	,,	0	1	0	,,
Naphthalene, all qualities.					
Pitch...............f.a.s. Manchester.	,,	1	13	0	per ton.
Copperas: Green, in bulk	,,	0	12	6	,,
,, barrels f.o.b. L'pool	,,	1	19	0	,,
Cake	,,	1	2	6	,,
Copper: Sulphate		22	10	0	,,

	£	s.	d.	
Cyanides: 98% minimum ......f.o.b. net	0	0	8	per lb.
Lead: Acetate (Sugar) White. English......	27	10	0	per ton.
,, ,, ,, Foreign c.i.f. U.K	24	15	0	,,
,, ,, Grey	21	0	0	,,
,, ,, Brown at Manchester	16	10	0	,,
Nitrate	23	0	0	,,
Litharge, Flake	15	10	0	,,
,, Powder	16	0	0	,,
Red Lead, Genuine, c.i.f. London less 5%	15	10	0	,,
White ,, ,, Dry ,, ,, ,,	16	15	0	,,
Naphtha (Wood): Miscible, 60 o.p.	0	2	10	per gal.
Solvent..	0	2	7	,,
Potash: Bichromate... delivered England...	0	0	3	per lb.
Carbonate, 90/92 % ... c.i.f Hull ...	18	0	0	per ton.
Caustic, 75/80 % ...... ,, ,, ...	20	10	0	,,
Chlorate ....net	0	0	3 1/16	per lb.
Montreal.........in Store, Liverpool	35	0	0	per ton.
Prussiate, Yellow ....net	0	0	4 11/16	per lb.

		£	s.	d.	
Soda:	Ash, Caustic, 48 %, Ordinary ... ,,	5	5	0	per ton.
	,, ,, ,, Refined...... ,,	6	5	0	,,
	,, Carbonated, 48 %............ ,,	5	10	0	,,
	,, ,, 58 % (Ammonia Alkali) ....net	4	10	0	,,
	,, Bleachers' Refined Caustic 50/52 % .... net	6	10	0	,,
	Caustic, White, 77 %.............. ,,	10	10	0	,,
	,, ,, 70 %.............. ,,	9	12	6	,,
	,, ,, 60 %.. .... ,,	8	12	6	,,
	,, Cream, 60 %..... ....,	8	10	0	,,
	Crystals, in bags	3	0	0	,,
	,, barrels	3	7	6	,,
	Acetate .... c.i.f. Hull net	16	10	0	,,
	Bicarbonate, in 1 cwt. kegs............	6	15	0	,,
	Bichromate......delivered England...	0	0	2¼	per lb.
	Chlorate .... net	0	0	3$\frac{1}{16}$	per lb.
	Nitrate...ex quay Liverpool, ... ,,	11	0	0	per ton.
	Phosphate	9	5	0	,,
	Prussiate ....net	0	0	3⅝	per lb.
	Silicate, Solution, 140° Tw.	4	10	0	per ton.
	Sulphate (Glauber Salts)...............	1	12	6	,,
	,, (Saltcake, 95%)...............	1	15	0	,,
Sulphur:	Recovered	4	15	0	,,
	Roll	6	15	0	,,
	Flowers..................................	7	10	0	,,
Zinc:	Sulphate	6	15	0	,,

MINERALS.

		£	s.	d.	
Barytes:	Lump Carbonate, 90/92%	3	10	0	per ton.
	Sulphate, No. 1, White	2	15	0	,,
China Clay:	of various qualities for all purposes; prices from about 11/- to about 30/- per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid.				
Chrome Ore:	Basis 50% c.i.f. British Ports...........	3	7	6	,,
Manganese:	Lump c.i.f. Liverpool 10¼d.				per metallic unit.
Ochre:	French JC .... f.o.b. Rouen, net	2	5	0	per ton.
	,, JF	5	10	0	,,
Talc:	(French Chalk).........c.i.f. Liverpool	3	10	0	,,

OILS, etc.

		£	s.	d.	
Aniline Oil	....................................net	0	0	4¾	per lb.
,, **Salt**	.... ,,	0	0	4½	,,
Castor Oil:	French, 1st pressure, f.o.b. Marseilles less 1½%.........	20	0	0	per ton.
	English, 1st pressure, f.o.r. Hull, less 2½%...............	21	15	0	,,
Cocoa Nut Oil:	Ceylon, ex store Manchester.............net	31	10	0	,,
	Cochin, ex store Manchester . ...net	33	0	0	,,
Cotton Seed Oil:	Refined at Hull, less 2½% naked	14	17	6	,,
	Edible...at Hull, less 2½% naked	15	7	6	,,
Glycerine:	Crude, 80% ....net	31	0	0	,,
Linseed Oil:	Raw... ..at Hull, less 2½% naked	13	10	0	,,
	Boiled......at Hull less 2½% naked	14	10	0	,,
Starch:	American Pearl...at Manchester, net	9	0	0	,,
	Dextrine........... ,, ,,	18	0	0	,,
	Farina............... ,, ,,	15	15	0	,,
Shellac:	Fair TN orange......................at	185/-			
Turpentine:	American.........at Liverpool	38	10	0	per ton.
	Russian ....at Hull...net	18	10	0	,,

TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote:—

COLONIAL WOODS.

Timber.

		£	s.	d.		£	s.	d.
Quebec Square White Pine...	per cub. ft.	0	1	9	to	0	3	0
Quebec Waney Board Pine...	,,	0	2	8		0	3	9
St. John Pine, 18 in. average	,,	0	2	3		0	3	3
Lower Ports Pine...............	,,	0	1	3		0	1	8
Quebec Red Pine	,,	0	1	6		0	1	10
Quebec Oak, 1st quality	,,	0	2	9		0	3	3
Quebec Oak, 2nd quality ...	,,	0	1	6		0	2	6
Ash	,,	0	1	6		0	2	3
Elm	,,	0	3	0		0	3	6
Hickory	,,	0	2	0		0	2	6
Quebec Birch	,,	0	1	6		0	2	8
St. John Birch	,,	0	1	6		0	2	0
Birch Planks.....................	,,	0	0	9		0	0	11
Spruce Spars	,,	0	0	10		0	1	0

Deals.

		£	s.	d.		£	s.	d.
1st quality Quebec Pine	per std.	22	10	0	to	32	10	0
2nd do. do.	,,	17	0	0		22	0	0
3rd do. do	,,	11	10	0		13	0	0
St. John, N.B., etc., Spruce	,,	6	10	0		6	15	0
Lower Ports Spruce......	,,	6	0	0		6	10	0
Spruce Boards..................	,,	5	10	0		6	0	0

UNITED STATES, etc., WOODS.

Pitch Pine.

		£	s.	d.		£	s.	d.
Hewn	per cub. ft.	0	1	3	to	0	1	8
Sawn	,,	0	0	10		0	1	6
Planks, Stowage	,,	0	0	10		0	1	0
Boards, Prime	per std.	12	10	0		16	0	0
Oak Timber	per cub. ft.	0	1	6		0	2	6
Oak Planks	,,	0	1	6		0	2	1
East India Teak..............	per load	12	0	0		15	0	0
Greenheart.....	,,	6	15	0		7	10	0

EUROPEAN WOODS.

Timber.

		£	s.	d.		£	s.	d.
Riga Redwood	per cub. ft.	0	1	9	to	0	2	3
Dantzic and Memel Fir, Crown	,,	0	2	1		0	2	6
Dantzic and Memel Fir, Middling	,,	0	1	9		0	1	10
Stettin	,,	0	1	9		0	1	11
Swedish.......................... ...	,,	0	1	2		0	1	4
Riga Whitewood	,,	0	1	3		0	1	6
Norway Mining Timber	,,	0	0	9		0	0	10
Dantzic and Stettin, etc., Oak..	,,	0	2	6		0	3	0
Norway Spars.................	,,	0	1	2		0	1	9

Deals.

		£	s.	d.		£	s.	d.
Red Archangel and Onega, 1st quality	per std.	19	0	0		20	0	0
Red Archangel and Onega, 2nd quality	,,	16	0	0		17	10	0
Red Archangel and Onega, 3rd quality	,,	12	10	0		15	0	0
St. Petersburg, 1st quality...	,,	16	0	0		17	10	0
Do. 2nd ,, ...	,,	14	0	0		15	0	0
Gefle	,,	14	0	0		17	10	0
Wyburg	,,	12	10	0		14	0	0
Uleaborg	,,	12	10	0		14	10	0
Gothenburg	,,	14	0	0		17	10	0

SELECTED PATENTS.

Compiled expressly for this journal by **Messrs. Page and Rowlingson, Engineering Patent Agents, 28, New Bridge Street, London, E.C.,** and at Manchester.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton Buildings, Chancery Lane, W.C., at the uniform price of 8d.

NEW PATENTS APPLIED FOR.

When Patents have been communicated the names of the communicators are printed in italics.

27,645. A. H. R. Pope, Bristol. Dec. 19th —Apparatus for automatically supplying an intermittent flush for urinals, sewers, and the like, or for measuring liquids.

27,669. W. H. Chipperfield, London. Dec. 19th.—An improved screw nut.

27,728. A. J. Boult, London. Dec. 19th.—Improvements in and connected with conveyors, or apparatus for transferring goods from place to place. (*The Alvey-Ferguson Co., U.S.A.*)

27,729. A. J. Boult, London. Dec. 19th.—Improvements in and connected with conveyors, or apparatus for transferring goods from place to place. (*The Alvey-Ferguson Co., U.S.A*).

27,731. R. F. Carey, London. Dec. 19th.—Improvements in or connected with driving and reversing mechanism for use with steam, oil, or other power propelled vehicles, stationary engines or mechanism.

27,734. H. Soar, London. Dec. 19th.—An improved speed indicator and recorder.

27,750. P. Goldmann, London. Dec. 19th.—Improvements in mechanical movements.

27,769. R. A. Griffiths and H. Mills, Birmingham. Dec. 20th.—Improvements in bearings for revolving shafts or spindles.

27,777. R. E. Atkinson, London. Dec. 20th.—Improvements in connection with heating systems, and apparatus for use therewith.

27,815. W. F. Probert, Bristol. Dec. 20th.—Improvements in boilers for heating water for domestic or other purposes.

27,847. L. Karzenstein, London. Dec. 20th —Improvements in packings for moving parts of machinery.

27,875. Aktiebolaget Separator, London. Dec. 20th.—Improvements in and relating to centrifugal separators for liquids. (Date applied for, Dec. 21st, 1903.)

27,876. Aktiebolaget Separator, London. Dec. 20th.—Improvements in and relating to centrifugal separators for liquids. (Date applied for, Dec. 21st, 1903.)

27,877. The Hydroleum Motor Company, Ltd., and J. Badger, London. Dec. 20th.—Improvements in and relating to fluid pressure engines.

27,878. The Hydroleum Motor Company, Ltd., and J. Badger, London. Dec. 20th.—Improvements in and relating to metallic packing.

27,880. W. O. Duntley, London. Dec. 20th.—Improvements in lubricators.

27,889. A. L. Davis, London. Dec. 20th.—Improvements in and relating to mechanical feeding and stoking apparatus.

27,924. T. Scully, Waterford. Dec. 21st.—Improvements in steam engines.

27,928. C. W. S. Turner, London. Dec. 21st.—Improvements in safety attachments for locomotives. (Date applied for, Dec. 22nd, 1903.)

27,935. H. E. Baly, Norfolk. Dec. 21st.—A combined crank handle and disengaging gear.

27,945. N. W. Abbey, Bradford. Dec. 21st.—Improvements in or relating to hydraulic cylinders.

27,961. M. S. Napier and C. Ricci, London. Dec. 21st.—Machine for grinding the teeth of spur and other wheels.

27,999. G. Machlet, London. Dec. 21st.—Improvements in air or gas pumps.

28,005. A. H. Kress, London. Dec. 21st.—Improvements in steam drying attachments for steam boilers and the like.

28,030. W. Beardmore and E. Field, London. Dec. 21st.—Improvements in or relating to locomotive and other engines using a mixture of steam and air.

28,092. E. Fry and R. Mills, Blackheath. Dec. 22nd.—Improvements in steam furnaces.

28,097. F. Sacchi, London. Dec. 22nd.—Improvements in pumps for raising liquids.

28,106. A. J. Boult, London. Dec. 22nd.—Improvements in or relating to multiple cylinder engines. (*Ehrhardt and Sehmer Ges. m b.H., Germany.*)

28,174. W. J. Pickering, Birmingham. Dec. 22nd.—Improvements in connection with the automatic feeding of steam boilers by gravitation under steam pressure.

28,185. W. Baur, Germany. Dec. 23rd.—A device for greasing driving belts.

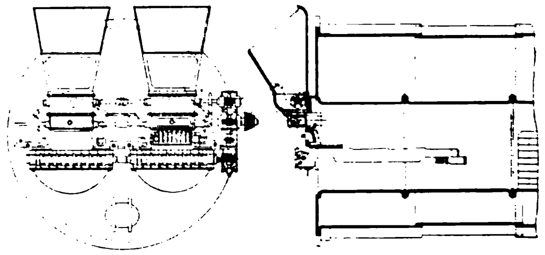
28,204. T. E. Barralet, London. Dec. 23rd.—An improved water heater or boiler.

28,231. J. R. Park, London. Dec 23rd.—Improvements in or relating to driving mechanism.

RECENT SPECIFICATIONS.

STEAM GENERATORS.

J. Hodgkinson, Manchester. Feb. 3rd. 1904.—The invention relates to automatic stokers for boiler furnaces of the separate types known as "coking" and "sprinkling." The object of this invention is to combine in one system both "coking" and "sprinkling," so that either of the two may be used separately, or both together. The coal is placed in the hopper at the bottom of which is an adjustable spring plate which directs the fuel to the revolving spirally-grooved crusher and measurer, from which it falls in measured quantities through the aperture in the path of a reciprocating ram, which pushes it over the distributing plate on to the "dead plate." Each alternate firebar is advanced a short distance towards the front of the furnace, the remaining alternate firebars being momentarily checked and then also advanced. The whole of the firebars are then returned together, which movements have the effect of carrying the fuel over the bars to the end of the furnace. In conjunction with the "coking" device a "sprinkler" of any well known form or construction, or a "spreader" jet supplied with steam or compressed air from any suitable source, is used.



METALS AND ALLOYS.

Marquis Albert de Dion and Georges Bouton, Puteaux, France. (Date applied for under International Convention, April 23rd, 1904.)—Refers to the manufacture of case-hardened articles of chrome-nickel steel. The invention consists in cementing chrome-nickel steel without subsequent hardening by quenching. The required result could not be obtained with mere chrome-steel, for with these compounds no martensite (constituting well hardened steel) is produced, but what is technically known as troostite (constituting steel hardened at too low a temperature) is produced as troostite, or with but little martensite. With some chrome-nickel steel, practically pure martensite is obtained simply by cementation carried on until the exterior portion contain the requisite amount of carbon, depending on the contents in nickel and chromium, and steel is obtained of great hardness of surface without quenching.

GOVERNORS.

The British Thomson-Houston Company, Ltd., and F. Samuelson, London. Jan. 30th, 1904.—The invention relates to emergency governing devices for steam turbines, electrical or other machines of the type in which a centrifugally operating governing device is employed to effect the release of an automatically acting valve, or other controlling device, so that the power supplied to the machine or current delivered from the machine in the case of an electric generator is automatically cut off when the speed becomes excessive. The device consists of an unequally distributed mass arranged about a revolving shaft, the outer surface of this mass being yieldingly maintained concentric with the shaft at normal speeds of rotation by means of a spring, but adapted to assume an eccentric position and thereby to operate a controlling device. This eccentric movement is utilised through a pivotted member and suitable link mechanism to operate the releasing gear of an automatic valve operating device or other apparatus controlling the supply of power to or from the machine, when the speed exceeds the normal.

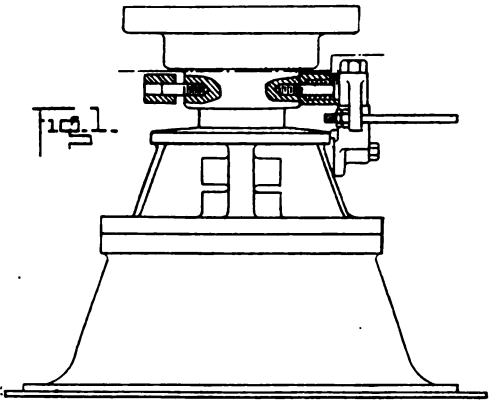


Fig. 1.

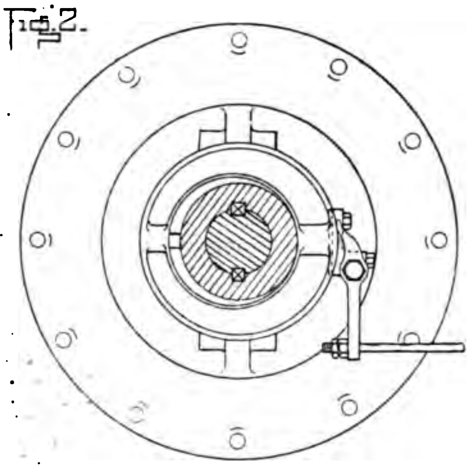


Fig. 2.

OIL ENGINES.

J. E. Thornycroft and T. Thornycroft, Chiswick. Nov. 30th, 1903.—According to this invention, in oroer to increase the efficiency and improve the working of oil engines, and also to obviate to some extent the great waste of heat that usually takes place therein by reason of the necessity of water jacketing the combustion chambers and engine cylinders, the oil used to form, in conjunction with the air, a combustible mixture, is forced into the combustion chamber of the engine by means of high pressure steam which, when the combustible mixture of air and oil is exploded, will, by the absorption of some of the excess heat of combustion, be further increased in pressure, and by admixture with the products of combustion and hot gases will form a more effective motive fluid for working the engine than products of combustion and hot gases alone as heretofore. The invention consists in an oil engine, wherein the oil used to form in conjunction with air a combustible mixture is forced into the combustion chamber of the engine by means of high pressure steam from a steam generator or by heat from the hot exhaust gases of the engine; the supply of oil and steam to the combustion chamber being controlled by a valve device comprising a valve casing connected to an oil pump and to a steam generator, and a valve arranged to control the passage of the oil and steam from the valve device to the combustion chamber, the arrangement being such that when the valve opens, oil supplied by the pump will be blown or sprayed into the combustion chamber by the steam.

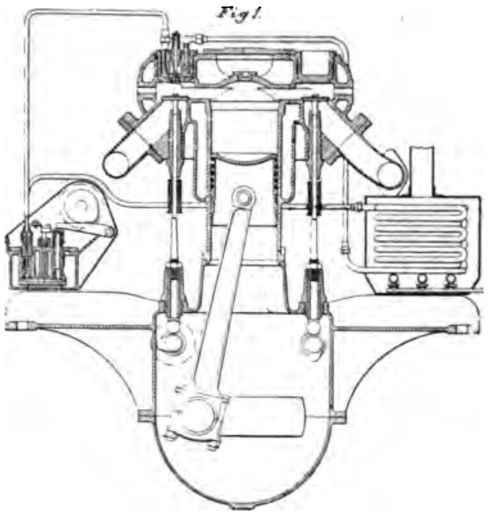


Fig. 1.

CALENDARS AND DIARIES.

The British Steam Specialities, Ltd., of Fleet Street, Leicester, and 73, Farringdon Road, London, forward a neatly bound pocket diary for 1905. A quantity of postal and other information, tables for the use of engineers, price lists of steam traps, valves, "Royal Gem" boilers, wrought-iron tubes and fittings and ventilating grates, etc., have been included.

We have received from Messrs. W. T. Glover and Co., Ltd., of Trafford Park, Manchester, their third annual tear-off sheet almanack. This is mainly composed of extracts from the Proceedings of the Institution of Electrical Engineers, and the Incorporated Municipal Electrical Association. Photographs of a number of prominent central station engineers have also been included, together with views of main laying, etc., and original contributions. All these are carefully interspersed, so that users can turn to Messrs. Glover's calendar with the certainty that every day there will be something new.

Messrs. Gordon and Gotch, Publishers' Agents and Export Merchants, send us a substantial folding blotting pad bound in dark crimson gilt. This is particularly useful to engineers, as on one side there is a neat envelope and pad with squared paper, while bound to the right-hand side with a silken cord is an "Every hour" diary for 1905.

Messrs. Kramos, Ltd., of Bath, forward their showcard for 1905. This firm is making a speciality of electric drills for high speed tool steel, electric lifting blocks, special motor combinations and "Kramos" patent resistance pieces. We have also received list No. 2 of the firm's High-speed Electric Drilling Machines.

Messrs. Shand, Mason and Co., of 75, Upper Ground Street, E.C., have issued a large wall sheet calendar, which also shows a number of their fire-extinguishing appliances.

Walter Judd, Ltd., Advertising Contractors, of 5, Queen Victoria Street, E.C., have issued a neat blue leather calendar, the dates for each month being printed in red and black on a separate card. The sheet calendar has also been issued by this firm.

Messrs. Robert A. Thompson and Co., Ltd., of 5, Tudor Street, E.C., forward a useful pocket diary for 1905, and we have also to acknowledge the receipt of a wall sheet calendar from Messrs. Boot and Son, Ltd., of 32, Fleet Lane, Old Bailey, E.C.

Messrs. Howard Bros., of Liverpool and London, have issued a novel calendar, the groundwork of which is a facsimile of their "Dey" Time Register. It is of the type known as perpetual, and as it is mounted on tin, should serve to indicate the time of "Dey" for many years.

Messrs. Clayton, Son and Co., Ltd., of Hunslet, Leeds, have produced a well-mounted wall calendar in green and gilt with a tear-off slip for each month from January 1905 to December 1908 inclusive. The calendar incidentally reminds us that the firm manufactures gasholders, boilers, purifiers, scrubbers, condensers, and all kinds of apparatus, roofs, and structural work. etc.

The Société Nouvelle des Etablissements Decauville aîné, of 13, Boulevard Malesherbes, Paris, forward a humorous wall calendar, printed in bright colours, and illustrative of their rail and motor-car specialities.

Messrs. Partridge and Cooper, Ltd., forward a selection of their excellent Desk Diaries and Wall Calendars. These are fully up to the standard of the firm.

NEW PUBLICATIONS.

"THE ELECTRIC FURNACE."

By Henri Moissan. Translated by A. T. de Mouilpied, M.Sc., Ph.D. Edward Arnold. 10s. 6d. net.

Professor Henri Moissan's experiments and researches in connection with the electric furnace have been so fruitful that it has been a source of regret to many that the translation of his *Le Four Electrique* has not appeared before. Since he began his work on this subject, the development of the various industries associated with the electric furnace has proceeded with remarkable rapidity. The first chapter of this admirably produced volume describes the different types of furnaces utilised in these researches, and their application to the study of the fusion, and the utilisation of a number of refractory bodies; chapter II. is a study of the three varieties of carbon; the following section discusses the preparation of some elements in the electric furnace, including chromium, manganese, molybdenum, tungsten, uranium, vanadium, zirconium, titanium, silicon and aluminium. The fourth section deals with the researches carried out on some new series of binary compounds, particular attention being paid to the preparation of calcium carbide. The concluding chapter, which was specially written for this translation, contains an interesting account of the most recent researches.

"ELECTRICITY IN THE SERVICE OF MAN."

A popular and practical treatise on the applications of electricity in modern life. By R. Mullineux Walmsley; D.Sc., F.R.S.E. Cassell and Co. 10s. 6d.

Although founded on a work of the same name, which appeared in 1888, and consisted chiefly of a translation from the German, this volume can scarcely be regarded as a second edition, there being every evidence that it has been entirely re-arranged and rewritten. The scope of Dr. Walmsley's work is very extensive and we know no book calculated to give the young student a more comprehensive account of the rapid growth of electrical science than the volume now before us. The writer deals with this subject under the following heads: principles of magnetism; electrostatics; the electric current; elementary laws of simple continuous currents; the chemical effect of the current; the thermal effects of the current; the magnetic effect of the current; electro-magnets; simple measurements in continuous current circuits; the electric telegraph; magnetic electric induction; the telephone; dynamical or magnetic production of the electric current; alternate currents and alternators; electric transmission of power; electric motors; alternate current measurements; the electric discharge; the technology of electricity; continuous current generators; alternators; batteries of generators; continuous current motors; dynamo and motor testing; alternate current motors; electrical measurements. The work is profusely illustrated and contains a number of folding, detailed drawings.

NEW CATALOGUES.

The Pulsometer Engineering Company, Ltd., forward an illustrated pamphlet on the "Criton" Water Softener.

Messrs. Mather and Platt, Ltd., have just issued a second edition of their Polyphase Motors catalogue.

We have received from the Lodge and Shipley Machine Tool Company, leaflets describing and illustrating their new patent head lathe.

The Mirrlees Watson Company, Ltd., of Glasgow, forward an attractive and artistic pamphlet dealing with the surface condensing plant employed for the Manx Electric Railway. This plant deals with the exhaust steam from two Belliss and Morcom engines of 600 h.p. each, and consists of a surface condenser, with twin steam-driven air pumps, and an electrically driven centrifugal circulating pump. The plant is capable of dealing with a normal duty of 18,000 lb. of exhaust steam per hour. Some attractive photographic illustrations and diagrams are included.

MEETINGS FOR THE ENSUING WEEK.

SATURDAY, JAN. 7th.—Birmingham Association of Mechanical Engineers: President's Inaugural Address, Grand Hotel, 8 p.m.

MONDAY, JAN. 9th.—Institute of Marine Engineers: Meeting at Romford Road, Stratford, 8 p.m.—North-East Coast Institution of Engineers and Shipbuilders: Meeting at Newcastle-on-Tyne.

TUESDAY, JAN. 10th.—Institution of Civil Engineers: Ordinary Meeting at Great George Street, Westminster, 8 p.m.

THURSDAY, JAN. 12th.—Institution of Electrical Engineers: Ordinary Meeting, 92, Victoria Street, 8 p.m.

FRIDAY, JAN. 13th.—Junior Institution of Engineers: Professor B. Lewes, F.I.C., F.C.S., lectures on the "Theory of the Incandescent Mantle" (illustrated by experiments and lantern slides), Westminster Palace Hotel, 8 p.m.—Institution of Electrical Engineers (Manchester Students' Section): Paper by Mr. A. E. Jepson on "Electric Heating," Sackville Street, 7.30 p.m.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

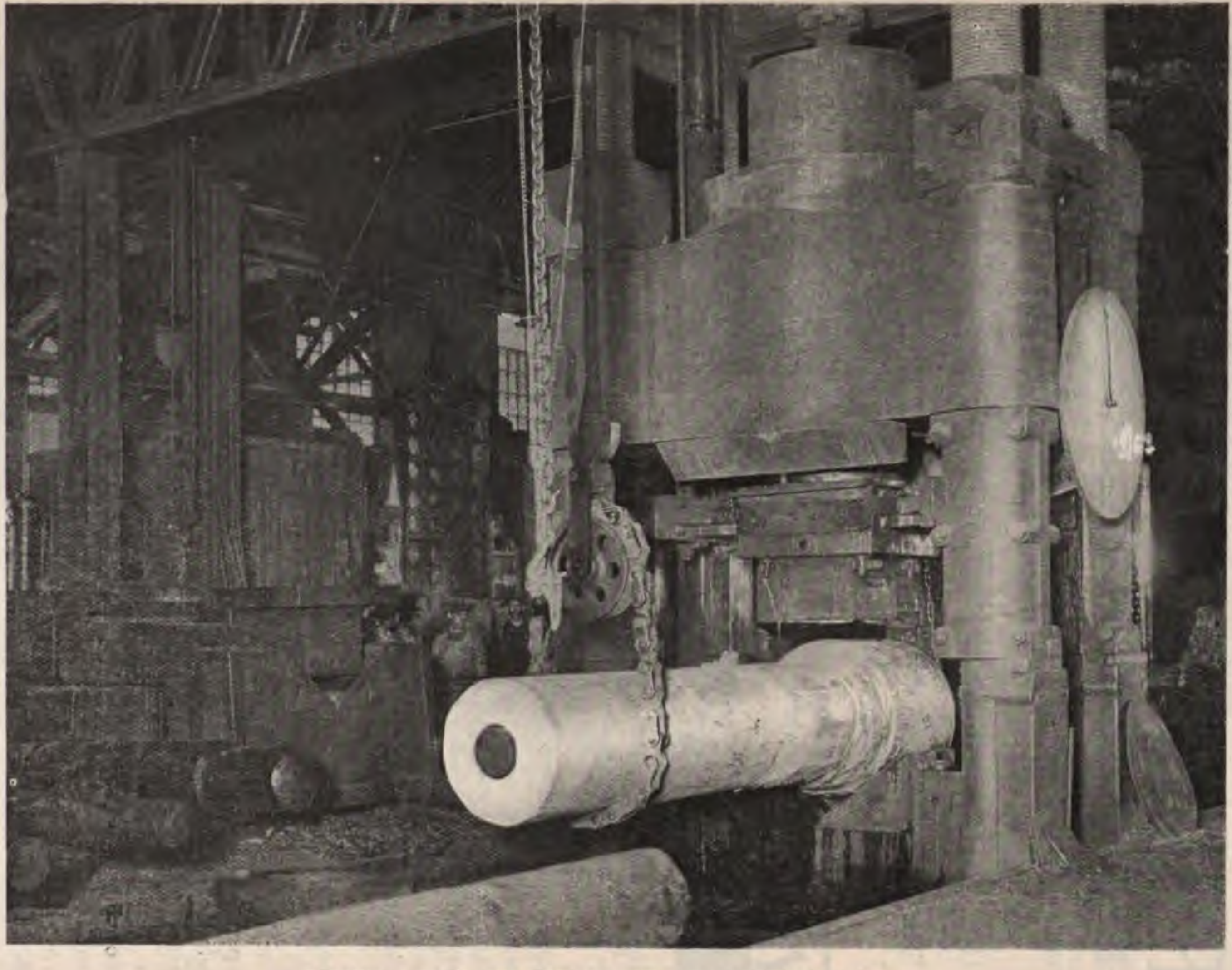
VOL. VI. LONDON, FRIDAY, JANUARY 13, 1905. No. 18.

The Offices of "Page's Weekly," Wednesday, Midnight.

HOWEVER efficient the furnace may be, when considered merely as an apparatus for the combustion of fuel, the means of absorbing and transmitting the heat generated to the water in the boiler, are at least equally worthy of careful consideration. The ideal furnace is not surrounded by comparatively cold water-space walls, but by heat-reflecting surfaces of fire-brick, whereby the high temperature essential to perfect combustion is attained, and I have already advocated the use of such a furnace or combustion chamber as an adjunct to the boiler.

To ensure the condition of working a furnace through the maximum range, we must not only have the highest initial temperature, but the lowest practicable final or chimney temperature; this being evidently determined by the efficiency of the heat-absorbing surfaces of the boiler. Under ordinary conditions it is seldom that the temperature of the gases at their exit from the boiler can be got much below from 500 to 600 deg F. Again, with natural draught, the efficiency of the chimney is at its maximum when the unit weight of the gases passing through it is one half that of the air at the outside temperature. Supposing this to be at 62 deg. F., the temperature of the gases within the chimney, to fulfil this condition would have to be 552 deg. F.; assuming 24 lb. of air to be drawn in and burnt with each pound of coal, there would be nearly 25 lb. of gases to be heated through 490 deg F. Their specific heat (or the quantity of heat required to raise the temperature of one pound of gases through one degree F.) is ·238 of a heat unit. So 25 × 490 × ·238, or 2,915 heat

MONUMENT TO PETER TUNNER—THE NESTOR OF THE AUSTRIAN IRON TRADE,
Which has just been unveiled at Lesben. (*See page* 59.)



FORGING A 12-IN. GUN TUBE IN THE BETHLEHEM STEEL WORKS.

The block has a hole bored through its centre, and in this the mandrel is inserted, the tube being forged around it The hydraulic pressure for this 5,000-ton press is furnished by Whitworth pumping engines. The department also contains a 2,500-ton press of similar design. (*See page* 69.)

units are, in a sense, utilised in producing the draught in the chimney. Taking the heat value of the coal as 14,000 units, this amounts to nearly 21 per cent. of the whole value of the fuel.

This seems a heavy price to pay, but it must be remembered that the temperature of the water on the other side of the plates or tubes forming the heating surfaces may be 350 deg. or more, and that at any rate the products of combustion could not, without abstracting heat from the water, leave the flues at a lower temperature than this. In loco-type boilers it is well known that far more water is evaporated by the heating surface of the firebox in proportion to its area than by any other in the boiler. The results of experiments on the different portions of the heating surfaces of boilers differ so much that it is impossible to fix any very definite figures, but we may take it that the efficiency of the firebox in terms of the total heating surface is from 50 to 66 per cent. of the whole. One case is recorded by Mr. Hutton in which 70 per cent. of the whole evaporative duty was borne by the firebox; 15 per cent. by the first quarter of the tube surface; 7 per cent. by the second quarter; 3 per cent. by the third; and 2 per cent. by the last quarter. With an initial temperature of 2,500 deg. F. this would result in the escape of the gases at a little over 600 deg. At any rate this is sufficient to show the rapidly diminishing value of the heating surface; each successive equal portion transmitting a less and less quantity of heat, so that an enormous addition to the tube surface would be required to materially reduce the temperature below that actually utilised in producing natural draught. In Lancashire boilers the case is very much the same, the furnace tubes performing nearly all the evaporation, especially when conical cross tubes are fitted in the flues. These, it may be noted, should be placed as far as possible from the fire, otherwise they have the effect of extinguishing flame and lowering the temperature of the furnace gases by abstracting heat before combustion is completed.

But to return to the escaping gases. Although practically incapable of imparting further heat to water at temperatures corresponding to high pressure of steam, there is a considerable field of usefulness open to them before making their final ascent through the chimney. By their passage amongst the numerous tubes of the well-known Green's economiser their heat is greedily absorbed by the cold feed water passing through the tubes, with the result, to quote a recorded test, that while the gases were chilled down from 618 deg. F. to 365 deg. the temperature of the feed-water was raised thereby from 88 deg. to over 225 deg. The rapidity of ascent of the column of gases within a chimney is measured in inches of water, and the simple apparatus necessary to register this is a useful addition to any steam boiler. If the draught, when everything is in the best working order is known, the stoker will have to keep his fire of proper thickness, evenly spread, and his firebar air-spaces clear, or his lack of attention will be visible at the draught gauge. It consists of a glass tube, any diameter, bent into the form of the letter **U**, one end being in communication, by an iron pipe, with the current of gases within the smokebox or the flue at the base of the chimney, while the other end is open to the atmosphere; a small quantity of coloured water being poured into the tube, the difference of level in the two legs of the **U** will show the pull of the chimney, and may be directly measured either by the scale attached, or by an ordinary rule.

Water is just 820 times as heavy as air at 62 deg. F., hence an inch of water would balance a column of air 820 in. in height. Against this, however, we have to set the weight of the column of heated gases within the chimney, which at 552 deg. F. is one-half that of the external air, the resultant effect being, under these conditions, that one inch difference of level in the two legs of the gauge indicates a draught or pull due to a column of the lighter gases, that is to say, [illegible] ft. in height. The draught in inches of water, therefore, at or near the inside and outside temperatures mentioned, equals [illegible] times the height of the chimney in feet. If the heating surfaces are covered upon the fire side with soot or upon the water side with scale, or far worse with a layer of grease, the increased temperature of the gases passing away will cause a measurable difference in the draught, and indicate the need for examination.

CORRESPONDENCE.

Timperley, near Manchester,
January [illegible]

To the Editor of Page's Weekly.

Dear Sir,—As from time to time doubts have been expressed in your columns as to the steam raising value of towns' refuse, we enclose extract of letter from the engineer-in-charge of the destructor plant at Burnley, where the results are so satisfactory that they have now had [illegible] a further installation to deal with the balance of the refuse of the borough. We doubt if there are many coal fired boilers of the same size giving as much steam when burning best Welsh coal, whereas our fuel is unscreened town's refuse.

Yours truly,
Meldrum Bros., Ltd.

The extract referred to from the [illegible], October 21st, 1914, "Burnley Destructor," is as follows:—

Until the end of August last a weekly return of water evaporated by the boiler was sent to the members of the Health and Electricity Committee. This water was measured by a Kennedy hot water meter, and for several weeks was checked by an automatic recorder on our Weir pump. Just recently the makers of the meter have certified it as working correctly. The following figures are taken from the weekly returns for the quarter ended [illegible]:—

Refuse weighed in Tons.	Water evaporated in lb.
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
212	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
210	[illegible]
*181	[illegible]
212	[illegible]
221	[illegible]
200	[illegible]

In each of the above cases, except the last, the water evaporated is for six days; in the last case it is for seven days.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

DAVIDGE PAGE, Editor.

Clun House, Surrey Street, Strand, London, W.C.

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Telegraphic and Cable Address: [illegible]

Editorial.—[illegible] *the paper only,* [illegible] *The Editor.*

[illegible] *MSS.* [illegible]

[illegible] *Page's Weekly* [illegible]

Correspondence [illegible]

[illegible]

Subscription Rates per Year.

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When Foreign Subscriptions are sent by Post Office Orders, advice should be sent to the Publisher.

Foreign and Colonial Subscribers receiving their [illegible] copies through newsagents, are requested to communicate the fact to the Publisher, together with the agent's name and address.

New Copy for Advertisements.

Alterations and [illegible] intended for insertion in the current week's issue must be delivered **not later than 4 p.m. on Monday.** If proofs are required the copy and blocks should reach us several days earlier.

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NEWS ITEMS.

A branch railway, four miles long, designed by Sir John Wolfe Barry, has been opened for mineral traffic between the Barry Company's line and the Brecon and Merthyr line.

A Times naval correspondent states that considerable alterations and additions are being made to the battleship *King Edward VII.*, to fit her for liquid fuel as an alternative to coal.

Messrs. Andrew Brown and Co., of 110, Cannon Street, London, E.C., have been appointed the London and District Agents for Messrs. Penman and Co., boiler makers, Glasgow.

Professor Gisbert Kapp, whose brief biography recently appeared in PAGE'S WEEKLY, upon his appointment at Birmingham University, has been made an honorary member of the Physical Society of Frankfort.

The Phœnix Dynamo Manufacturing Company, Ltd., of Thornbury Works, Bradford, have opened an office at 17, Victoria-street, Westminster. This will be in charge of Mr. E. W. T. Ward, who has recently joined their staff as London representative.

It is announced that the Lancashire and Yorkshire Railway Company have purchased the fleet of the Goole Steam Shipping Company, consisting of eighteen steamers, and will run them to the Continent in connection with their railway service to the East Coast.

We hear that Mr. P. M. Sankey has left the firm of Messrs. Johnson and Phillips, where for the past seven years he has been works manager of the Electric Cable Works. We wish Mr. Sankey every success in the future.

Sir William H. White, K.C.B. (Director of Naval Construction and Assistant Controller of the Royal Navy, 1885–1902), has commenced practice at 8, Victoria Street, Westminster, S.W. By wire he will be addressed," Navalhood, London," and by telephone, 1565, Westminster.

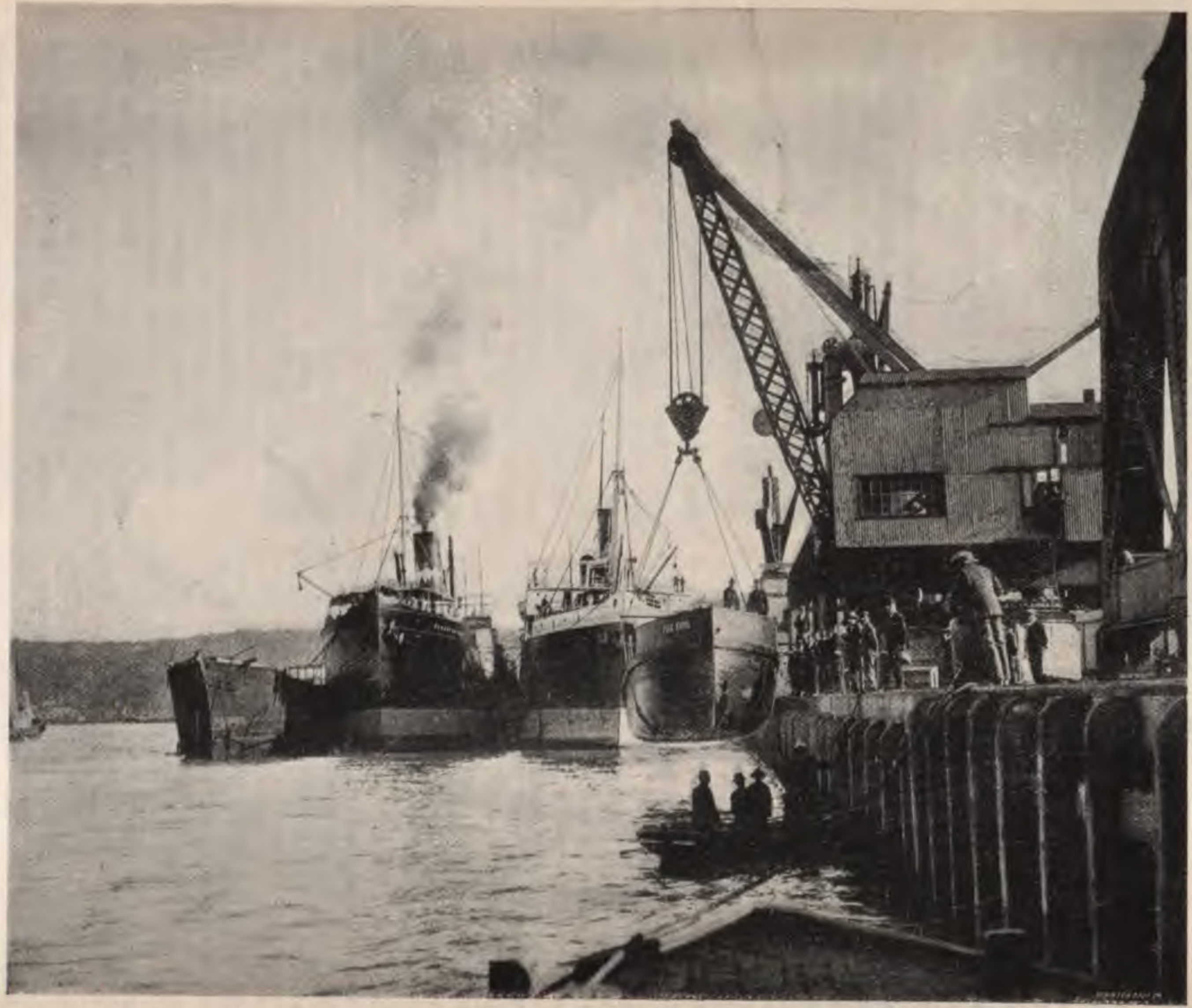
Mr. Charles De Grave Sells, M.Inst.C.E., who went to Italy some eighteen years ago under an arrangement with the Italian Minister of Marine, is now practising on his own behalf, and is acting as the representative of English firms in connection with marine engines and machinery, etc. His official address is Corniglialño, Ligure, Italy.

During the last ten weeks great progress has been made with the new University buildings at Birmingham. One of the large engineering blocks is now roofed in, and shafting for driving the metal and woodworking machines is being erected. For the special vacation course in metallurgical work, conducted by Professor Turner, the maximum number of students has already been enrolled.

Sir James Dewar, at a meeting of the Royal Society of Edinburgh, said he felt it a very high honour to follow in the footsteps of the great man who had already received the Gunning Victoria Jubilee prize. It was his intention to hand over the money value of the award to the University of Edinburgh so that it might go towards the fund being raised for the memorial of the late Professor Tait.

The Peter Tunner Memorial.

On June 8th, 1897, the Nestor of the Austrian iron trade, Peter von Tunner, died at Lesben at the age of 89 years. The work begun by Tunner in 1840, as lecturer on the metallurgy of iron and continued with astonishing energy for a lifetime, was the foundation of scientific metallurgy. He was one of the first to appreciate the importance of the Bessemer process, and its introduction into Austria was due to his energy. As an author he was continually active. His last monograph was an account of the iron industry of Styria, prepared on the occasion of the visit of the Iron and Steel Institute to Austria in 1884. Honours were showered upon him by monarchs, municipalities and scientific societies. In 1878 he received the Bessemer Gold Medal from the Iron and Steel Institute of which he had long been a member. His services to metallurgy have not been forgotten since his death, and a worthy monument to his memory has now been erected at Lesben, the scene of his long-continued activity, funds for the purpose having been contributed by his former pupils and by members of the Mining Society of Styria, of the Iron and Steel Institute, and of other societies of which he was an honorary member. The monument was recently unveiled with great ceremony. It is constructed of granite with the figures in bronze. A mining student and an iron-smelter are represented in the act of winding an oak and laurel wreath round the base of the bust. The sculptor was Mr. Carl Hackstock.



(*From The Syren and Shipping.*)

BUFFALO HARBOUR, EAST LONDON. FIFTY-TON CRANE LOWERING NEW FIRE FLOAT INTO RIVER AFTER LANDING EX. SS. "FORT SALISBURY." WEIGHT, 35 TONS.

Harbour Works at East London.

The writer of an article on "The Ports of South Africa," in the new year's number of the Syren and Shipping, makes some comments on the Port of East London, which illustrates forcibly the difficulties which were encountered in dealing with the river bar.

East London, he says, has an admirable inner harbour, access to which, however, is sometimes impossible, on account of the bar and narrow ingress, obstructed, as this has been, by a ridiculously extended middle training wall, devised in days when what were known as "freshets" used to occur frequently on the Buffalo River (which forms the inner harbour), and "scouring" methods were the best approved and most in vogue for the bar clearance. Curiously enough, these freshets have almost entirely ceased to operate in the Buffalo channels, and the training wall, which was meant to co-operate with nature, has latterly proved an artificial obstruction to the entrance of long vessels, unless at considerable risk. The harbour problem at East London is not so much one, as at Durban, of depths on the bar, or of draughts of vessels crossing the same, but of access in the steering ways and of width of entrance or egress channels.

The engineering which narrowed the channel to assist a natural scour was right, so far as it went, for the day or the conditions it had to contend against; but it was not prospective engineering; and when the natural scour surceased, almost, if not quite permanently, the narrowness of the entrance channel and the meagreness of steering and turning way, consequent upon the existence of the middle training wall, became a fresh adversity. In face of this, however, betterment has been gradually achieved; and, although the conditions at the Buffalo mouth cannot hold a candle to those at the entrance to Durban harbour, yet there is every indication that in the future the reverse may be the case. So long as a vessel does not exceed 20 ft. or 21 ft. draught and 450 ft. length, she can enter at most states of the tide or sea, and, once inside, can lie in smooth river waters alongside wharves which are fitted with the latest and best appliances for landing and clearing cargo.

The article from which the above details and the illustration on the opposite page are taken, is only one of many features of interest in this excellent number which gives a comprehensive resumé of the progress made in shipping affairs during the past year.

A Theory of Water-finding.

The Times is apparently trying to clear up the mysteries attendant upon water-finding, and in Wednesday's issue an interesting theory is advanced by Mr. Sydney F. Walker, of Bath. There is so much misapprehension as to the forces underlying the operations of the professional water-finder, and his occupation, in spite of practical success, is so often looked upon as a species of charlatanry, that any attempt to explain the matter scientifically is worthy of more than passing notice. We have no space to quote from Mr. Walker's column at length, but his ideas are given in brief in the following paragraph.

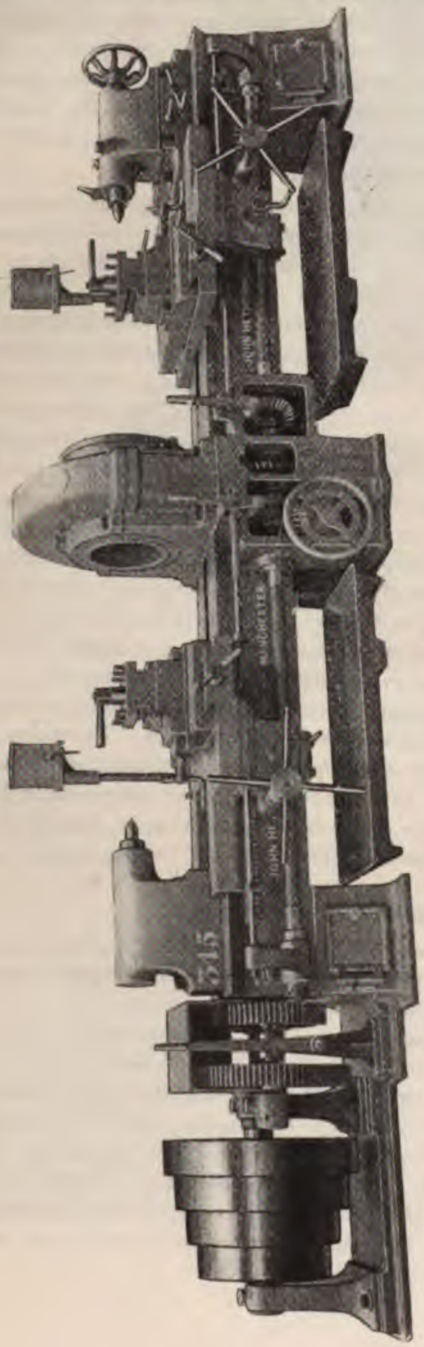
The operator, he says, is merely the instrument that responds to the force generated by the underground spring, just as a gold-leaf electroscope responds to the force delivered by an electrostatic charge. A portion of the energy present in the running water underground is converted into a form of energy that has been hitherto unknown, and is at present without a name, but which possesses some of the properties of the other physical forces and responds to some of their laws. The principal property it possesses, so far as is known at present, is that of stimulating the nerves controlling some of the muscles of the hands, and thereby causing certain muscular movements of the fingers, which are rendered visible usually by the forked twig that has become associated with the operation of water-finding. The forked twig is merely the indicator, showing the presence of the energy transformed by the running water, just as the diverging gold leaves of an electroscope indicate the presence of an electrostatic charge. The energy, in the form described, passes from the ground, up through the body of the operator, to the nerves controlling the muscles of the hands, producing in those muscles the movements which cause the twig to turn.

Geological Society Awards.

The council of the Geological Society of London will this year award the medals and funds in their gift as follows: The Wollaston medal to Dr. J. J. Harris Teall, M.A., F.R.S.; the Murchison medal to Mr. Edward John Dunn, of Melbourne; the Lyell medal to Dr. Hans Reusch, Director of the Geological Survey of Norway; the Bigsby medal to Professor J. W. Gregory, D.Sc., F.R.S.; the Wollaston fund to Mr. H. H. Arnold-Bemrose, M.A.; the Murchison fund to Mr. H. L. Bowman, M.A.; and the Lyell fund to Mr. E. A. Newell Arber, M.A., and Mr. Walcot Gibson.

IMPROVED DOUBLE-AXLE TURNING LATHE.

We are indebted to Messrs. John Hetherington and Sons, Ltd., for the accompanying illustration showing improvements which have been recently made in double-axle turning lathes for high speed cutting.



IMPROVED DOUBLE-AXLE TURNING LATHE, BY MESSRS. JOHN HETHERINGTON AND SONS, LTD.

These lathes are specially designed for turning at high speed each end of an axle at the same time. The axle is revolved in dead centres and is driven by a hollow spindle headstock through a Clements driver. Independent starting, stopping and reverse, self-acting sliding motion is given to each carriage by two separate steel guide screws and gun metal half nuts with instantaneous release motion. There is a fixed ratio of positive and continuous feeds, giving 32, 16, 8, and 4 cuts per inch traverse through cut gearing. This can be changed by the indexed hand wheel in front of the lathe while the latter is in motion. Each carriage is also fitted with an adjustable independent automatic stop motion to the feed in both directions.

The lathe is fitted with compound slide rests, one to each saddle, with a revolving steel capstan tool holder suitable for two tools; also with spring catch and locking handle. The bottom slide and carriage form drain troughs, collecting and delivering the lubricant into trays beneath the bed.

The driving headstock is of massive design, the hollow cast-iron spindle revolving in adjustable parallel bearings, and the cap and headstock forming an entire cover to the main driving wheel on the spindle.

The dead centre headstocks are movable, the right-hand one being fitted with a sliding spindle of hard steel, adjustable by screw and handwheel, split nose, locking bolt and centre. It is mounted on a saddle fitted with a coarse pitch screw, by which means it can be quickly traversed transversely in order to pass the axle through the driving headstock spindle. The left hand dead centre headstock is fitted with a fixed spindle and loose centre.

The lathe is driven by a four-speed cone pulley of large diameter suitable for a wide belt of high velocity, while the double cut gear provides for an instantaneous change from high-speed cutting to slow-speed cutting for finishing, etc.

The following are the chief dimensions:—

Height of centres, 13 in.; to turn in diameter up to 8½ in.; to admit between centres, 8 ft.; diameter of hole through spindle, 12 in.; length of bed, 13 ft.; width and depth of bed, 20 in. by 12½ in.; gear ratio, 9·23 and 33·6 to 1; diameter of pulleys and speed of countershaft, 22 in. by 7 in.: 460; cutting speeds per minute at maximum diameter 75, and with belt on large step of bottom cone pulley, 20; Approximate b.h.p. required, 27; approximate weight of lathe, 136 cwt.

NAVAL NOTES.

WEEKLY NOTES ON NAVAL PROGRESS IN CONSTRUCTION AND ARMAMENT.

(BY OUR NAVAL CORRESPONDENT.)

FRANCE.

THE boilers of the two armoured cruisers *Jules Ferry* and *Jules Michelet* will be of the *Du Temple-Guyot* type, with small tubes, but the majority of the other vessels under construction will be fitted with Niclausse or Belleville steam generators with large tubes.

It appears that when the battleship *Justice* was launched by the Société de la Mediterranée, her hull was considerably strained, and an inquiry is to be held into the manner in which vessels are launched by this company.

The next programme of construction is expected to contain particulars of a new class of protected cruiser, approximating to the scout type of the British navy. They are to be of 3,000 tons displacement, with 26 knots speed, and the first batch will probably be laid down in the course of this year.

GERMANY.

Progress with the new battleships for the German navy is rapid, but it is noteworthy that like the *Schwaben*, the *Elsass* has met with a serious accident while running her trials. She was finishing her circle turning trials according to one report, when she lost her rudder, owing to the pressure of water. Although this report is quite credible, there must have been something seriously wrong with the construction of the vessel, and she will be some little time making good the damage done. The battleship *Braunschweig* on her full power trials made an average of 18·43 knots, and at an endurance trial of eleven hours' duration the average indicated horse-power was 11,588. The armoured cruiser *Friederich Karl* has not given very satisfactory results on her trials, only attaining 18·7 knots with 17,759 horse-power, and later under better conditions of wind and weather, 20·5 knots. The protected cruiser *Bremen* made an average 23·288 knots on her full power, her highest speed being 24·466 knots. Two seagoing torpedo boats, Nos. 123 and 125, the latter fitted with turbine machinery, have made over 28 knots on trial. An accident occurred to the *Prinz Adalbert* when steaming at full speed on her trials, the high-pressure cylinder of one of her engines bursting.

RUSSIA.

"The Emperor has sanctioned the expenditure of £160,000,000 for rebuilding the Russian navy." In these bald words the St. Petersburg correspondents announced the new scheme for the replacing of the squadrons which Russia has lost in the war. The programme is to cover ten years, and many of the vessels will be built abroad. The building programme is to consist of eight battleships of the *Kniaz Suvaroff* type, eight of the *Andrei Pervosvannui* class, six armoured cruisers, twelve protected cruisers, fifty destroyers, and one hundred torpedo boats.

The Third Pacific squadron which is fitting out in great haste at Libau will take practically every remnant of the Russian fleet from European waters, with the exception of the Black Sea Fleet, which is pinned up behind the Dardanelles. Whether the squadron under Admiral Mebagatoff will be ready to start in another fortnight is doubtful, but urgent commands have been issued for it to do so.

UNITED STATES.

The new battleship *New Hampshire* will be built by the New York Shipbuilding Company, and the contracts for the two armoured cruisers *North Carolina* and *Montana* have been awarded to the Newport News Company. The battleship is to be completed in thirty-eight months.

Two more submarines have been ordered from the Holland Submarine Company, and unless the Latre Company come forward and compete, the remainder of the appropriation authorised by Congress in the summer will be expended on *Holland* boats. There are already eight submarines of this type in the United States' navy.

THE NETHERLANDS.

The Dutch Navy budget for 1905 provides for the completion of the battleship *Tromp*, the four torpedo boats, G1–4 (of which G 1 was launched on December 17th and G 2 on December 28th, by the Schelde Company), and one submarine. A new battleship "E" is to be laid down and four more torpedo boats, sisters to G 1, are to be begun. The torpedo boats Tangka, Wajang, and Smeroe have made 25·6, 24·7, and 24·6 knots respectively on trial.

SUBURBAN LOCOMOTIVE, PENNSYLVANIA RAILWAY.

SUBURBAN RAILWAY TRAFFIC.

By A. W. Sullivan.

THE advent of the electric tram has compelled the attention of railway men, and it is therefore not surprising to find that the question of suburban traffic has been very carefully considered by the International Railway Congress. In response to a circular of inquiry by the Congress on the question of suburban traffic, replies were received from one hundred and twenty-nine railways, of which ninety-seven stated that they had no suburban traffic, and thirty-two gave information which forms the basis of a report by Mr. A. W. Sullivan. Of these railways, twenty-eight are in the United States, one in Canada, two in the Argentine Republic, and one in Brazil.

TOLLS, FARES, AND TICKETS.

In the United States and Canada, it is the universal custom to provide but one class of car in suburban service. A distinction, however, is made in the use of cars, smoking being permitted in some but not in others. In many of the Southern States separate cars are required by law to be provided for the exclusive use of negro passengers.

Upon the railways of the Argentine Republic and of Brazil both first-class and second-class cars are used. It is found to be the almost universal practice to charge fares in suburban service varying according to distance. An approximation to a zone system of fare is made upon some roads, where for convenience in accounting, several stations near together are placed in a group, and tickets for different stations in each group sold at the same rate; or, where competitive conditions restrict the fare that may be charged to a number of stations in quite an extensive district; but such instances of zone rates are not the result of a systematic development of the zone system, which it may be said has no general application in America.

Great variation is found to exist in the suburban rates of fare as compared with the ordinary rates. Upon some railways the suburban rate is as low as one-fifth of the ordinary rate, while upon others the full ordinary rate is charged, the range being as follows:—

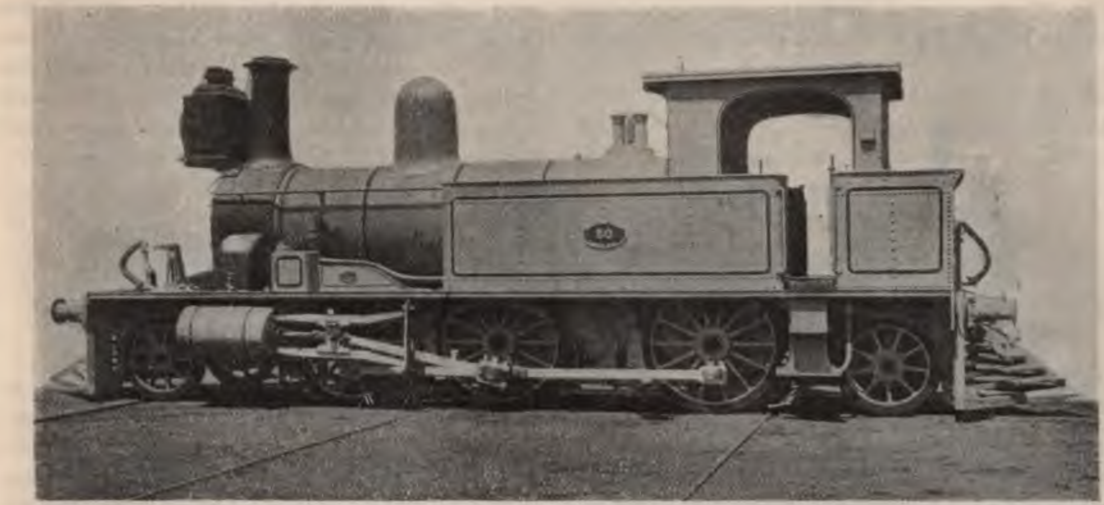
Number of railways.	Proportion of suburban to ordinary fares.	Number of railways.	Proportion of suburban to ordinary fares.
3	$\frac{1}{5}$	1	$\frac{3}{4}$
1	$\frac{2}{5}$	1	$\frac{5}{6}$
5	$\frac{1}{3}$	6	Full rates.
6	$\frac{1}{2}$	—	
3	$\frac{2}{3}$	26	

From the foregoing statement it will be seen that the average proportion of the suburban rates is 59–100 of the ordinary rates of the railways in the United States and Canada.

In Argentina, the suburban rates to near-by stations are in some instances higher than the ordinary rates for equal distances; to stations 8 and 9 miles distant, the suburban rates are about the same as ordinary rates; and for stations 10 to 13 miles distant, the suburban rates are somewhat less than ordinary rates, the average for all distances being about equal to ordinary rates.

The second-class rates in suburban service are found to average about 65 per cent. of the first-class rates for all distances.

The round trip rates average 80 per cent. of the rates for two single trips.

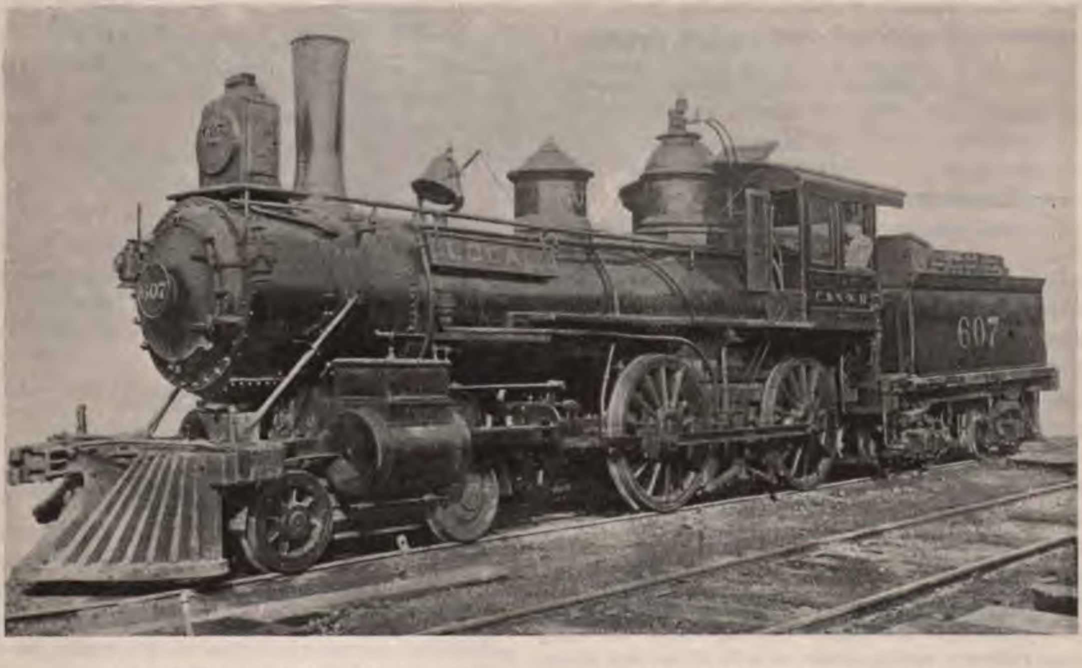


SUBURBAN LOCOMOTIVE. FERRO CARRIL DEL SUD (ARGENTINA).

Some difference of practice is found to exist upon railways in the United States and Canada in the matter of carrying of baggage upon suburban trains. In all cases, however, where baggage is handled the allowance is 150 lb. per passenger. In Argentina, all trains carrying passengers convey baggage, 110 lb. being the maximum weight allowed each passenger.

It is the universal practice in all countries to permit passengers to take with them into the cars such parcels and packages as may be disposed of under the seats or in racks overhead, without inconvenience to other passengers.

The forms of tickets used appear to be of endless variety in size, shape, colour, and the conditions under



SUBURBAN LOCOMOTIVE, LOCAL SERVICE. CHICAGO AND NORTH WESTERN RAILWAY.

LOCAL SERVICE TRAIN ON THE CHICAGO AND NORTH WESTERN RAILWAY.

which they may be used. The range in time of use extends from one day to an unlimited period, and, in the number of rides, from a single trip to as many trips as may be desired to be taken in one year.

CHARACTERISTICS OF SUBURBAN LINES AND PERMANENT WAY.

The range of practice in respect to the use of tracks for suburban trains is so varied, that the results have been tabulated in the following statement :—

	Number of railways.		Number of railways.
1 track.. ..	2	2 and 4 tracks..	5
2 tracks ..	11	2, 3 and 4 tracks	1
1 and 2 tracks..	7	4 tracks ..	1
1, 2 and 3 tracks	1		—
1, 2 and 4 tracks	4	Total ..	32

Three railways report that a portion of their line is circular, around which trains are worked continuously; upon the other twenty-nine railways trains are reversed for movement in each direction.

The gauge of the suburban tracks upon twenty-seven railways in the United States and Canada is 4 ft. 8½ in., measured between the inner faces of the heads of the rails, and is known as the standard gauge. Two railways in the United States report gauge of track as 4 ft. 9 in. In Argentina, one railway reports its gauge as 5 ft. 6 in., and in Brazil the gauge is reported by one railway as 5 ft. 3 in. In the United States no distinction is made in the rolling stock used upon railways having gauge of 4 ft. 8½ in. and those of 4 ft. 9 in.; the gauge of the car wheels admitting of their use upon either gauge of track.

The distance from centre to centre of main track ranges on railroads of standard gauge (4 ft. 8½ in.) from a minimum of 11 ft. 6 in. to a maximum of 15 ft. In Argentina the distance is reported 13 ft. 9 in., with a track gauge of 5 ft. 6 in.; and in Brazil 12 ft. 3 in., with a track gauge of 5 ft. 3 in.

SIGNALLING.

In the United Sttaes and Canada block signals are in general use upon the suburban lines of twenty-five railways; only four railways in the United States, which have very light traffic, operate without the use of a block system.

The use of block signals for suburban traffic is also well established in Argentina and Brazil.

Of the block systems in use in the United States and Canada, fifteen are automatic, being operated either electrically or pneumatically; six are manual; three are combined automatic and manual; and one railway uses an automatic system in combination with the electric staff.

In Argentina and Brazil, the manual block system is used.

STAFF.

As to the employees on suburban trains, it is found that for a minimum train service they consist of a crew of two men on the locomotive, the engineman and the fireman; and a crew of two men on the cars, the conductor and the flagman, making a minimum crew of four men to each train. It is the general practice to confine the duties of the engine crew to the care and management of the locomotive, the engineman being especially charged with the movement and proper stopping of the train. The train crew is required to make collections of the tickets and fares, to assist passengers in getting on and off the cars, to preserve order and to perform such other duties as will ensure safe and proper service.

The conductor is chief in authority, and the other employees on the train are required to yield willing obedience to his orders in the performance of their duties; although, in matters affecting the safe movement of the train, the engineman is upon many railways held equally responsible with the conductor.

METHOD OF WORKING.

Upon all the railways of America suburban trains are operated by steam locomotives. All the locomotives so used are simple engines, except that upon one railway in the United States (the Erie Railroad) and one in Argentina (the Buenos Aires, Rosario and Central Argentine Railway) a few compound locomotives are in service. The steam pressure of the simple engines ranges from 130 to 200 lb. with an average pressure of 160 lb. per square inch. The steam pressure used on the compound engines of the Erie Railroad is 180 lb. and upon the compound engines of the Buenos Aires, Rosario and Central Argentine Railway 170 lb. per square inch.

Bituminous coal is used for fuel on the locomotives of twenty-one railways; anthracite coal is used on nine railways, all of which are in the United States; coke is used on one railway, which is also in the United States. A few railways in the United States use successfully a mixed fuel consisting of bituminous and finely broken anthracite coal in about equal proportions.

The size of the cylinders of suburban locomotives varies greatly, the range for simple engines being from 14 in. diameter by 22 in. stroke to 20 in. diameter by 24 in. stroke.

The compound locomotives of the Erie Railroad have cylinders 12½ in. and 21 in. diameter by 22 in. stroke, and those of the Argentina Railway 16 in. and 23 in. diameter by 24 in. stroke. The suburban locomotives most recently built are simple engines with two large-sized cylinders and high steam pressure.

Locomotives with four driving wheels are generally used in suburban service, although most of the locomotives recently constructed have six drivers. The range of diameter is from 48 to 68 in., the average being 60 in.

The weight upon the driving wheels and the total weight of the locomotives in suburban service range are shown in the accompanying table:—

Locomotive.	Weight upon Driving Wheels.		Total Weight of Engine.	
	Minimum.	Maximum.	Minimum.	Maximum.
Loco. with four driving wheels	40,250 lb.	103,000 lb.	56,000 lb.	176,000 lb.
„ „ six „ „ ...	83,000 lb.	128,000 lb.	125,000 lb.	210,000 lb.

Locomotives which are constructed especially for suburban service are generally designed to run at speed in either direction to avoid loss of time in turning at terminals. Sixteen railways have locomotives so constructed, while fourteen railways which use upon their suburban trains locomotives taken from ordinary service turn them at each end of the line.

None of the railways in America have adopted electrical working for suburban service, although one railway, the New York Central is now arranging for the installation of electrical equipment.

The automatic compressed air brake is in general use in suburban service in America with satisfactory results; two railways, however, report using the vacuum brake, also with good results.

ROLLING STOCK AND MAKE-UP OF TRAINS.

For the lighting of cars, fourteen railways use gas; nine use oil; six use oil and gas; two use gas and electricity; and one uses oil, gas and electricity.

All the railways in the United States, except one, and the railways of Canada, use steam from the locomotive for heating the cars. One railway in the State of California, and the railways of Argentina and Brazil, report that the climate does not require the heating of cars.

The type of passenger car generally used in suburban service of the railways of the United States and Canada has a central aisle with a door and platform at each end. The seats have capacity for two passengers, are placed transversly of the car on both sides of the aisle, and are reversible so that the passengers ride facing forwards. These cars are of wooden construction and are carried on two trucks of four wheels each. The average length over the end sills of the underframe is 53 ft., the average number of passengers seated is 64, and the total average weight of car empty is 61,000 lb.

(*To be continued.*)

OUR WEEKLY BIOGRAPHY.

MR. ERNEST KILBURN SCOTT, M.I.E.E., A.M.Inst.C.E.

MR. E. KILBURN SCOTT, who is well known to our readers as the contributor of "Power Station Notes" and "Electrical Affairs," has been appointed to organise and take charge of the electrical engineering department at the Sydney University, New South Wales. He is a native of Leeds, and comes of an old engineering family—the firm of R. Kilburn and Sons, still carrying on a textile machine-making business, founded over 100 years ago.

He entered his grandfather's firm in 1883, and afterwards went through the erecting and fitting shops, and drawing office of Messrs. John Fowler and Co. On the recommendation of Professor A. Barr, M.Inst.C.E., whose student he has been at the Yorkshire College, he became assistant to Mr. Wilson Hartnell, M.I.M.E., and assisted in steam-engine governor design and in the installation of many early electric lighting installations in the North of England.

In 1890 he was appointed head draughtsman to Messrs. Clarke, Chapman and Co., who were then manufacturing Parsons turbines, and to W. T. Goolden and Co., who carried out much pioneer electrical work in collieries.

MR. E. KILBURN SCOTT, M.I.E.E., A.M.INST.C.E.

After two and a half years as dynamo designer to the Brush Electrical Engineering Co., he was invited to take charge of the drawing office of the Electric Construction Company, Wolverhampton. He subsequently did some consulting work, sending out the original plant for the electric lighting of Coolgardie, working up the details of the South Staffordshire power scheme. He also inspected and tested boilers, engines, alternators, and other plant for Mr. Robert Hammond, M.Inst.C.E.

The next three years were spent with Messrs. Johnson and Phillips, where Mr. Scott was responsible for the estimating and technical correspondence, and worked on the details of multi-phase transmission plants for Burma Ruby Mines, Raub Gold Mines, Regendze Gold Mines, etc.

In 1900 he was appointed engineer and manager in this country for the Compagnie Internationale d'Electricité of Liége. He established a London office and sub-agencies and carried out many important contracts, amongst them the first three-phase municipal installation at Erith, and a large three-phase power plant at the British Xylonite Works.

Two years later he was asked by the owner of the Salem Magnesite, Mines in Southern India to carry out some original electric furnace work in Norway. He succeeded in producing a highly refractory furnace lining from Magnesite and first suggested its use as a furnace wash. He also reported on the value of the Meraker 3,000 h.p. calcium carbide factory, and carried out work there with a view to arriving at the exact cost of manufacture.

Of late years he has acted as advisory electrical engineer in connection with the Bath tramways scheme, the Sunderland and District Electric Tramways; also the three-phase 10,000 volts transmission scheme at Snowdon, and the narrow-gauge railways connected therewith, which are to be worked with alternate current.

He has been lecturer in Electrical Engineering at the Northampton Institute for five years. He is well known as a technical writer, and is the author of a work on the "Local Distribution of Power in Factories," and numerous papers in the Proceedings of Societies.

THE WORKS OF THE BETHLEHEM STEEL COMPANY.

The works cover an area of about 175 acres. They include blast furnaces, puddling mills, Bessemer steel converters, rolling mills, open hearth furnaces, steam hammer and hydraulic forge press shops, machine shops, tempering and treating departments, etc.

STEEL FOR THE MANUFACTURE OF ARTILLERY.

BY LIEUT.-COLONEL CUBILLO (SPANISH ROYAL ARTILLERY).

II.

This article, continued from page 15, will be the more interesting to readers of PAGE'S WEEKLY by reason of the notes which we published a year ago giving Lieut.-Colonel Cubillo's ideas on the reconstruction of the Spanish Navy.

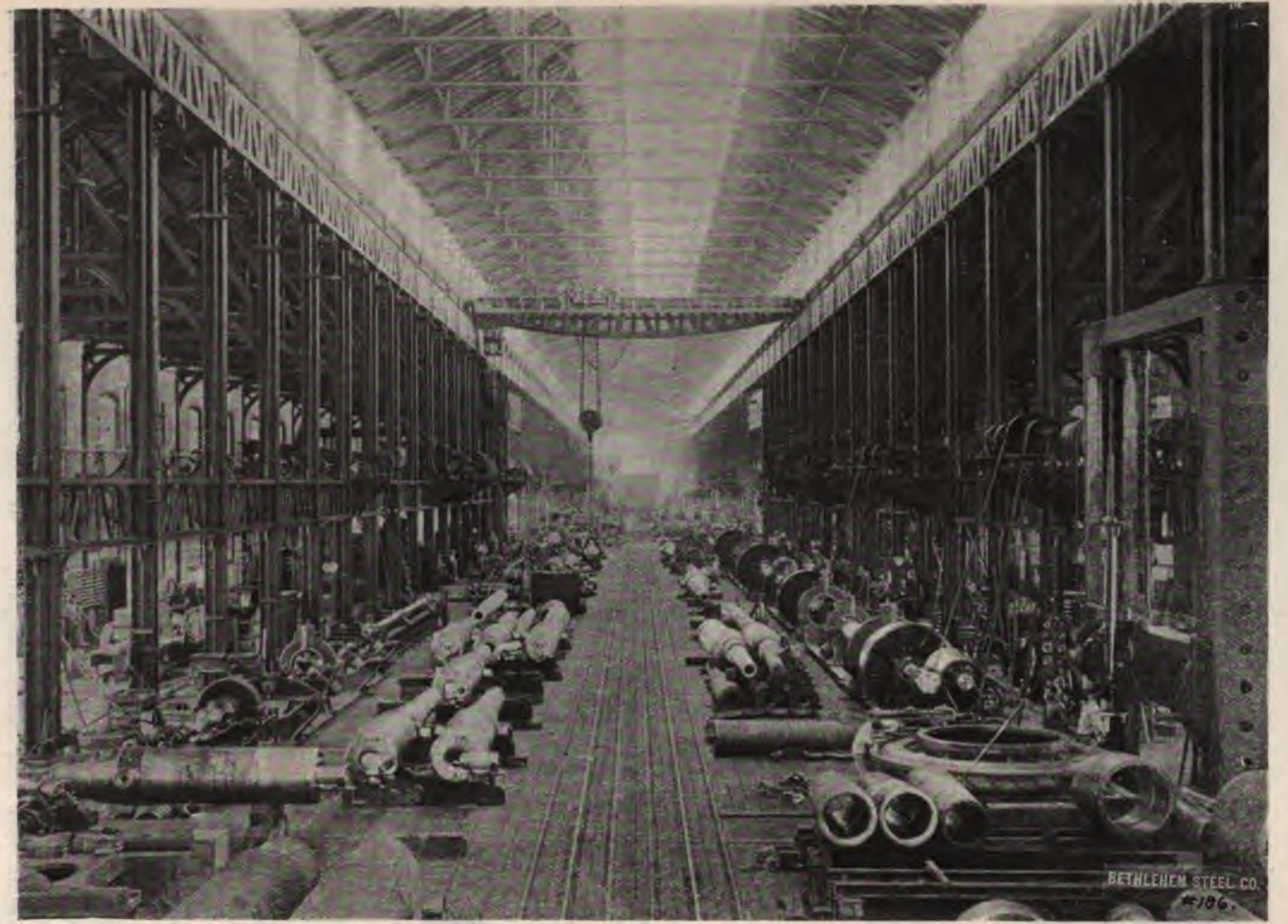
SOUTH BETHLEHEM is one of the greatest mechanical enterprises of the United States. It is an establishment similar to many in Europe devoted to the manufacture of war materials. Not in vain did John Fritz, the most eminent, perhaps, of all American metallurgists, remain at its head.

Without entering into a description of the furnaces and rolling mills, in this article, we will say that South Bethlehem, when the United States Government announced the idea of constructing a fleet and coast defences, offered its services to the Government without demanding subvention or even guaranteed contracts for a certain number of years. South Bethlehem risked more than any other company; Midvale began the manufacture of artillery materials; Homestead, armour plates; only Bethlehem installed a plant for the making of plates and complete guns. It is clear that anyone who attempts the manufacture of armour plates has more than sufficient plant for that of artillery materials, but South Bethlehem could say that they had erected two special installations, because, even if the Siemens' furnaces were common to both, the ingots used for the artillery material were treated by the fluid compression process, thus following the path and principles of Whitworth.

Money has not been stinted in South Bethlehem; everything relating to the preparation of first materials, furnaces and presses, is of the most modern type obtainable.

SIEMENS' PLANT.

As in all new factories in America and those in Europe which follow the American system, the artillery parks are of ample proportions and are served by electric cranes. In these parks are prepared the charges for the Siemens'



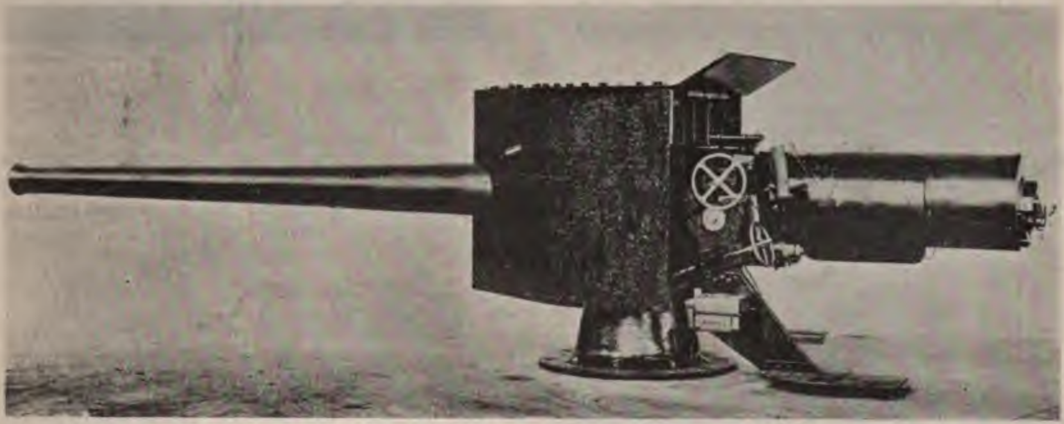
GUN FINISHING MACHINE SHOP OF THE BETHLEHEM STEEL COMPANY,

A sub-department of the general machine shop, which is the largest of the three machine shops in the Company's plant, being 1,466 ft. long and 117 ft. 6 in. wide. The gun finishing machine shop is equipped with the necessary machinery for finishing the parts of guns of all calibres, both before and after assembling, as well as their breech mechanisms. In this department the gun carriages and mounts are assembled and erected.

SHIPMENT BY THE BETHLEHEM STEEL COMPANY OF 606 TONS OF ARMOUR FOR THE IMPERIAL RUSSIAN BATTLESHIP "PETROPAVLOVSK."

The nickel steel plates are 16 in. thick, tapered to 8 in., and are 7 ft. 8 in. high.

furnaces, as in Trubia, in iron boxes of 3,000-kilogramme capacity, which are transported to the furnace platform in narrow-gauge wagons, each of which carries three boxes. Once in position, and the furnace being ready to receive the load, a Wellman electric crane effects the charging. The Siemens' furnaces at South Bethlehem are of great capacity and placed in a line with the casting pits in front. The fusion and refining of the loads are conducted in the usual manner; the amount of carbon, in conformity with the stipulated conditions for artillery steel is 0·45 per cent. In its application of the Whitworth process, South Bethlehem compresses the fluid steel in a press of 7,000 tons; one of the most powerful yet constructed. It is enough to say that the upper part weighs 120 tons, the lower 135 tons, and that the steel columns are 15 metres in length and 480 millimetres in diameter.



THE COMPANY'S 6-IN. 50-CAL. RAPID-FIRE GUN AND MOUNT WITH MINIMUM PORT SHIELD.

The shield is rigidly attached to the cradle of the mount and is carried with the gun as the latter is elevated or depressed. The shield plates are of Krupp armour, and can withstand the attack of 6-in. armour-piercing projectiles. The shield offers a maximum protection to the gun's crew without materially increasing the effort required in elevating and training the gun.

EXAMPLES OF GUNS DESIGNED AND BUILT BY THE BETHLEHEM STEEL COMPANY.

1-POUNDER SEMI-AUTOMATIC GUN AND MOUNT.

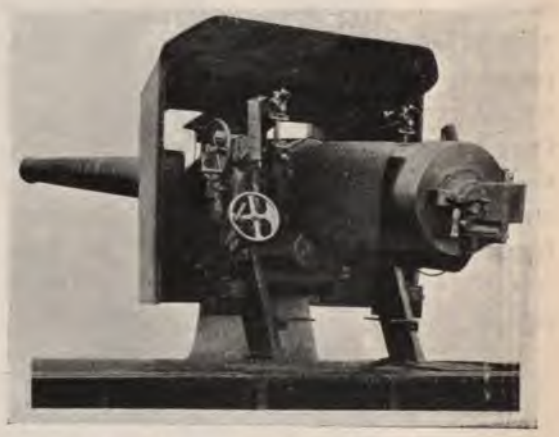
There are two presses used for the forging of artillery material, one of 2,500 tons, the other of 5,000.

FORGING A 40-CENTIMETRE GUN.

The possession of these powerful instruments enabled the South Bethlehem Works to undertake the making of the material for a 40-centimetre gun for the Watervliet Arsenal; the ingots smelted for the interior tube of this piece weighed more than 100,000 kilogrammes, and the 5,000-ton press was required to forge it. It was of nickel steel, and after the forging it was reheated, a convenient operation to obtain a uniform condition in the entire mass of metal. The hardening of the pieces is done in a workshop completely covered and closed on all sides, an arrangement which has advantages for the observation of the different temperatures at a glance, and protects the mass from currents of air which might chill certain parts of the tubes during the time they pass from the furnace to the oil bath. The gas furnace in which the tubes and sleeves are heated at South Bethlehem are completely buried, the mouth being level with the floor close to the oil tank. The tubes are again annealed which leaves the metal in the most perfect condition, correcting any prejudicial tensions to resistance which may have happened in the hardening.

4-IN. 50-CAL. GUN ON PEDESTAL MOUNT.

The gun is equipped with telescopic and night sights, and with electric and percussion pull-off firing gear.



6-IN. 45-CAL. RAPID-FIRE GUN ON PEDESTAL MOUNT.

The gun is equipped on both sides with telescopic and open sights, with night attachments, and can be trained from either side. The gun fires loose ammunition, with powder charge in brass cartridge case, and has electric and alternate percussion firing gear.

GUN FINISHING MACHINE SHOP.

The workshop for the machining of artillery material and the finishing of the parts is superb: it is sufficient to say that it is 420 metres in length and 35 metres in width. Served by electric cranes, it contains the most powerful and the most delicate machines, from the lathes and boring machines capable of receiving the inner tube of a 40-centimetre gun to the smallest machines for the manufacture of minute screws. Boring, rifling, chambering, screwing and sectioning machines, lathes from the great factories of the Niles-Bement-Pond Company, and some others, in great number, using the most perfect modern tools, fill this great space. A new workshop will shortly be added for the adjustment of breeches, and will complete this splendid plant, which, at present, is in charge of Mr. Meigs, a retired naval lieutenant, well known by his work on Ballistics, and as the inventor of a breech possessing manifest advantages over that known as the Velin.

South Bethlehem, like the firms of Vickers-Maxim, Armstrong-Whitworth, and others, not only manufacture tubes, sleeves, hoops and guns, but also carry on original experiments in field and coast defence artillery.

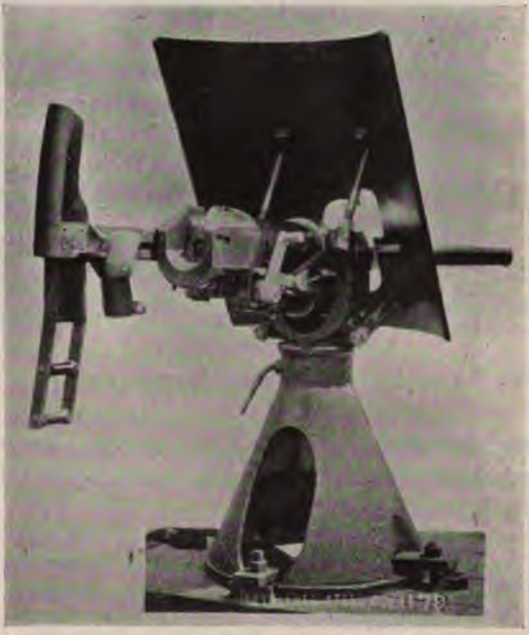
NEW GUNS.

The Artillery and Fortification Committee are at present proving two rapid-fire guns of 5 in. and 6 in., made by this firm, the first mounted to combine the properties of a disappearing carriage and rapid fire. The results of the tests with this gun are unknown; the 6-in. rapid-fire gun must have an initial velocity of 915 metres and throw a projectile weighing 45 kilogrammes. The rapidity of fire has been fixed at eight discharges per minute. The pressure has not been determined, but the contract stipulates that it must not be excessive.

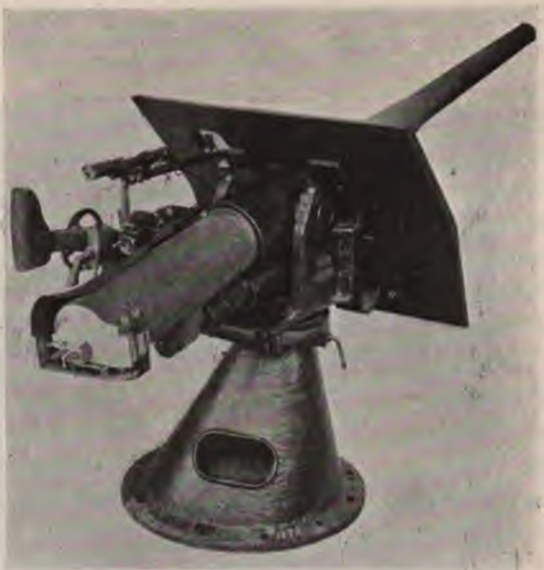
These are not the only contracts made by the South Bethlehem Company with the U.S.A.; by a deed signed on the 7th November, 1901, the Company arranged to deliver, completely finished, one hundred coast-defence guns, as follows: twenty-five of 8 in., fifty of 10 in., and twenty-five of 12 in.

South Bethlehem has delivered to the national factory at Watervliet the forged and tempered

FURTHER EXAMPLES OF THE BETHLEHEM STEEL COMPANY'S GUNS.

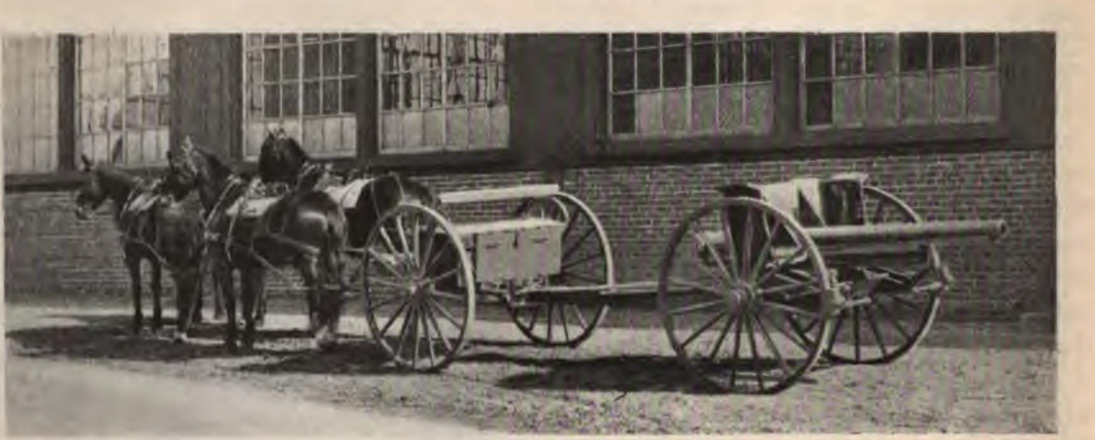


6-POUNDER SEMI-AUTOMATIC GUN AND MOUNT.



3-IN. 15-POUNDER RAPID-FIRE GUN ON PEDESTAL MOUNT.

The gun is equipped with telescopic and open sights, electric night sights and electric and percussion pull-off firing gear, and has hand gear for elevation and traverse on the mount.



3-IN. HORSE ARTILLERY GUN, LONG RECOIL CARRIAGE AND LIMBER.

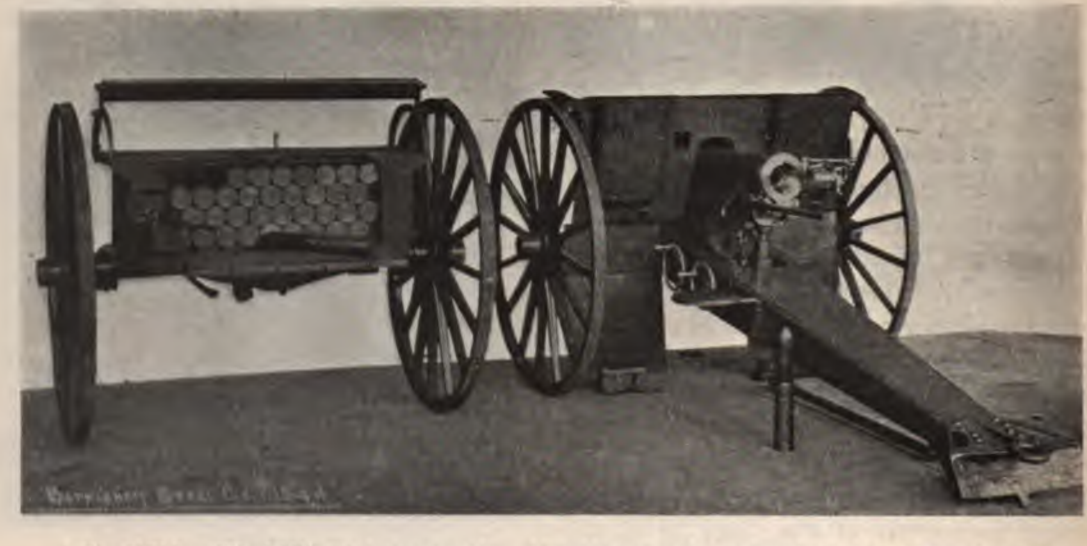
steel intended for tubes, the sleeves, hoops and accessories of other pieces detailed below :—

	lb.
71 for 6-in. Guns	188,514
33 ,, 10-in. ,, ...	300,826
55 ,, 12-in. ,, ...	861,612
2 forged pieces for 12-in. Howitzers ...	1,000
3 ,, ,, ,, 12-in. Guns	16,000
570 Ingots for forged pieces	239,000
	1,606,952

or 728,949 kilogrammes.

GUN TESTS AT SANDY HOOK.

As a question relating to the qualities of metal for the construction of pieces of artillery, I must speak of the experiments with a 15-centimetre gun made of simple cast steel, which have recently taken place at Sandy Hook. On January 19th, 1898, the Artillery and Fortification Committee placed an order with the Aktiebolaget Bofors Gullspang, of Bofors, Sweden, for the manufacture of a 15-centimetre



3-IN. FIELD GUN, LONG RECOIL CARRIAGE AND LIMBER, ALSO DESIGNED AND BUILT BY THE BETHLEHEM STEEL COMPANY.

The gun fires from seat on left side of trail, or by lanyard, and is provided with telescopic sight. The gunner is protected from rifle and shrapnel fire by shield on carriage.

rapid-fire gun, with pedestal carriage and one hundred rounds of ammunition. The price was $15,417, and one year was given for delivery. As usually happens the time for delivery was exceeded, and the gun was not received at the proving ground until July, 1901, and, owing to difficulties encountered in mounting, it could not be tested until March, 1902. Owing to the excessive amount of work pressing on the Experimental Committee the tests of this gun have proceeded very slowly; at the time of my visit to the United States it had been discharged 250 times. The gun is composed of three parts: barrel, sleeve, and breech. The projectile weighs 45 kilogrammes, with a velocity of 800 metres.

The screw opens and closes by one movement automatically, or by hand, as desired. The lodging of the lock is of conical form, with a large opening for the charge, and is provided with a tile of automatic action. The carriage is provided with two gears on both sides, so placed that one man attends to the elevation and another to the direction of fire. In the tests of rapidity of fire, ten shots have been discharged in 103 minutes when managed by hand, and the same number in 94·6 minutes when the screw has been opened and closed automatically. This automatic mechanism is perfect. It opens on the return of the gun to its cradle; in the return a spring is compressed and a kind of picklock holds it open. When the picklock is released the spring closes automatically. The working of this mechanism has been excellent during the tests. It is seen, by the results of the rapidity of fire tests, that the automatic lock does not possess any great advantages, but it economises space for the charge and requires one man less to handle the gun. As I have not been allowed to see this gun —no foreign officer being permitted to visit Sandy Hook—I have obtained the foregoing details from a paper by Commander Rogers Birnie, of the Fort Monroe School of Artillery, and if I am unable to give more details regarding this interesting gun, I may be allowed to make some observations upon the metal of which it is constructed. For many years the artillery factory of Bofors has applied cast steel to the making of guns, and it bases its studies on the well-known property of steel, by which it acquires all the physical qualities from its chemical composition, exclusively, by calorific treatment (hardening and reheating) and with a total independence of the intervention of hammers or presses.

When a bar is subjected to a hammer press or rolling mill, the forging, or rolling, fills two functions; the first, the principal and most important, is to impede the crystallisation of the heated metal, as would be the case if the blows of the hammer did not prevent it, a state of repose being necessary to crystallisation; the second, of less importance, is the shaping of the bar. The first operation, which gives the maximum tenacity and ductility to steel, is more easily and rapidly performed by hardening and reheating than by the slower process of forging.

Having described the methods employed in the Midvale and South Bethlehem factories, which alone supply the national workshops, we see that they do not differ from those used in Europe; there is no great progress to chronicle, the same quality of steel, obtained from raw materials of the same degree of purity, and an identical series of operations forming the total process of manufacture of the tube or sleeve. Touching the quality of the metal, carbonised or nickel, it appears impossible to improve it, or to obtain mechanical qualities superior to those of to-day.

(To be continued.)

QUESTIONS OF THE DAY.

The National Encouragement of the British Inventor: How can it be secured?

(*Continued from page* 34.)

THE CHARACTER OF THE PATENT OFFICE EXAMINING STAFF.

In the discussion on Mr. Abel's paper, dealt with in the last issue, Mr Oscar Guttman made the following observations :—

An objection was with regard to the quality of the examiners. He happened to know the quality of the junior examiners in Germany, and also knew the standard for the assistant examiners who were selected in this country for positions under the new patent law. He was afraid the Germans would come out better in that respect, but he did not wish to discourage the young men who would be assistant examiners; probably in a year or two they would have greater experience than they at present possessed. In Germany an assistant examiner must have been at some works and had some practical experience, or he must have undergone a course of very severe study. In this country assistant examiners were chosen, not according to the record of their study or work, but by means of the wonderful competitive examinations which existed in England, where generally not the clever men were at the top but those who went through an examination best, and it was well-known what a curse the examination system had been in this country in all sorts of professions.

THE COMPULSORY PUBLICATION IN THE PRINTED SPECIFICATION OF ANTICIPATIONS ARBITRARILY DEFINED BY THE PATENT OFFICE.

Sir Lloyd Wise in his contribution to the discussion on Mr. Abel's paper, observed :—

In the interest of inventors, I desire, if in order, to direct special attention to the new patent rules, which seem to me highly objectionable.

In my opinion they point to about the most obnoxious method that could possibly have been devised of carrying out the provisions of Section 1 of the Patents Act of 1902. This is the more unfortunate because effect might readily be given to those provisions in a manner that would prove advantageous both to inventors and the public.

I suggest, in particular, that the utmost possible pressure should be promptly brought to bear with the view of getting the rules so far modified that in carrying out Section 1 of the Patents Act, 1902, the special forms of reference to prior patents set out in Rule 10 of the Patents Rules, 1905, shall apply only in cases where the applicant has not already mentioned the prior patent in his specification, and has been duly notified of the Comptroller's determination that a reference to a prior specification ought to be made, and has failed to embody in his own specification, in his own way and within a specified reasonable time, a reference by number, year, and name to such prior specification.

According to the new rule 10, if the applicant once goes the length of troubling the Comptroller to determine whether reference ought to be made in the applicant's specification to any, and if so, what, prior specification or specifications by way of notice to the public; then, should the Comptroller's decision be affirmative, an official notice is to be placed upon the unfortunate applicant's specification in these terms :—

"Reference has been directed, in pursuance of Section 1, Sub-section 6, of the Patents Act, 1902, to the following specification of Letters Patent, No. ....granted to......................"

Where the reference is inserted as the result of a provisional report, under Rule 7, a statement to that effect is to be added to the reference.

Surely an applicant should be allowed to take a patent at his own risk, provided he (himself) specifically mentions the prior patent or patents, reference to which is regarded as necessary for the protection of the public. The mention thereof by No., year, and name, would obviously be a notice to the public, inasmuch as his specification is addressed to the public. Why, then, should it be in any way made known, to his prejudice, that he referred to the prior patent under compulsion? The contemplated practice will be tantamount to publication of an official report to the effect that, in the opinion of the Comptroller, the patent is invalid.

What justification can there be for thus handicapping inventors whom the patent laws are intended to encourage? *Why not give the patentee absolutely fair play?*

If the framers of the Act had contemplated the sort of practice seemingly intended to be set up, surely they would not have expressly prohibited, as they did in the Act, publication of reports of examiners, which, as a matter of fact, formed an essential part of the original scheme as approved by the Society of Arts, after full discussion, in 1877, and submitted by me, as the Society's delegate, to the International Congress at Paris in 1878.

MASTER CAR BUILDERS' DROP-TESTING MACHINE,

Installed at Purdue University.

BY WILLIAM F. M. GOSS,

Dean of the Purdue Schools of Engineering and Director of the Engineering Laboratory.

AT its annual meeting in 1898, the Master Car Builders' Association appointed a committee to define fully the contour lines of couplers, and to propose specifications which might guide railway companies. The report which it presented at the next annual meeting, recommended, among other things, that couplers offered to railways be subjected to a series of tests under a drop-testing machine. The committee not only defined the nature of these tests, but presented a design for a machine to be employed in carrying them out, and the present Master Car Builders' drop-testing machine was the outcome of its work.

The value of a drop-testing machine having become apparent, it was determined that the Association should provide itself with a perfected machine, and that the machine should not be in the keeping of a railway company, but should be established upon neutral ground. Since the air-brake testing rack and the brake-shoe testing machine of the Association had already been installed in the laboratories of Purdue University, the location for the proposed machine was easily chosen.

DESCRIPTION OF THE MACHIN

General elevations, sections, and a plan are shown in fig. 1. It will be seen that the machine rests upon a foundation of concrete above which it rises to a height of more than fifty-four feet. The anvil (A) is in the form

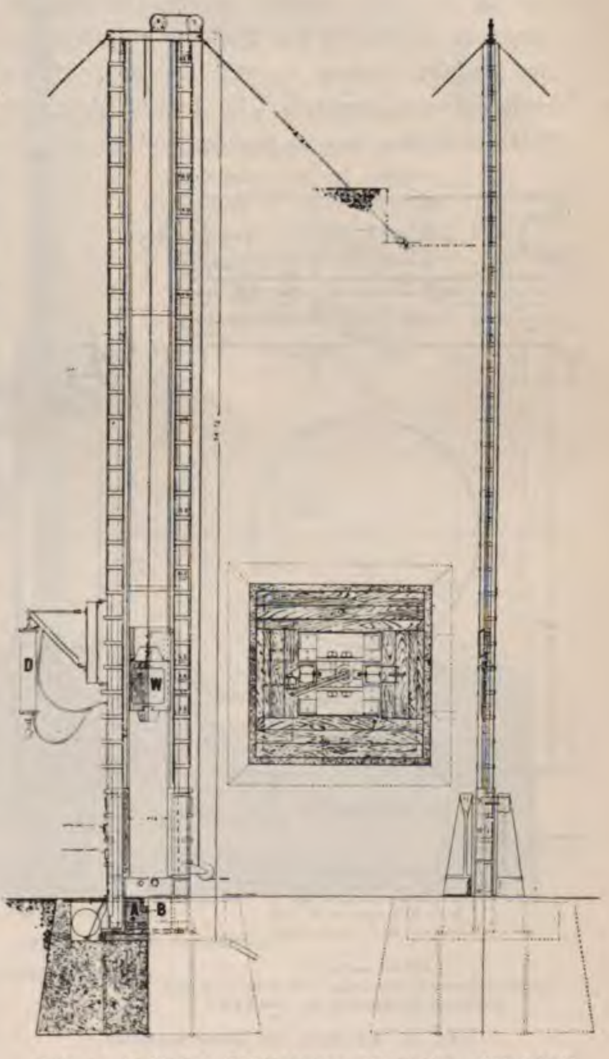


FIG. 1. GENERAL ELEVATIONS, SECTIONS, AND PLAN.

of a rectangular casting weighing 17,000 lb. For convenience in holding a coupler, as will hereafter be explained, it has in the middle an annealed steel insert (B). The anvil is carried by nests of coiled springs, which in turn bear upon a suitable foundation plate. The spring support of the anvil is intended to make the machine easily reproducible. It is assumed that the resisting qualities of an anvil thus supported will be the same whether the machine itself rests upon a rock foundation or upon soft soil.

The drop of the present machine, weighing 1,640 lb. is of forged steel and is shown in detail by fig. 2. This weight meets the requirements of the Master Car Builders' specifications for coupler testing as well as those of the International Association for Testing Materials, with reference to axle testing, and is made to meet the requirements of the specifications of the last-named Association for rail testing by fitting discs to the cylindrical opening in such a manner as to increase its weight to 2,000 lb. The drop is handled by a wire cable served by a small reversible hoisting engine (not shown in the drawings). The traveller above the drop carries a tripping mechanism so arranged that when a stop is set the drop is released from any predetermined height.

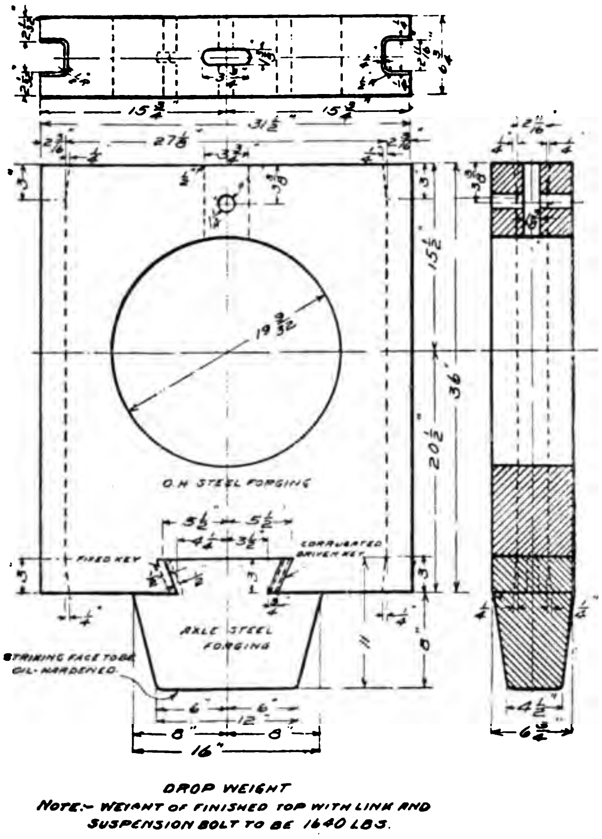


FIG. 2. DETAILS OF DROP WEIGHT.

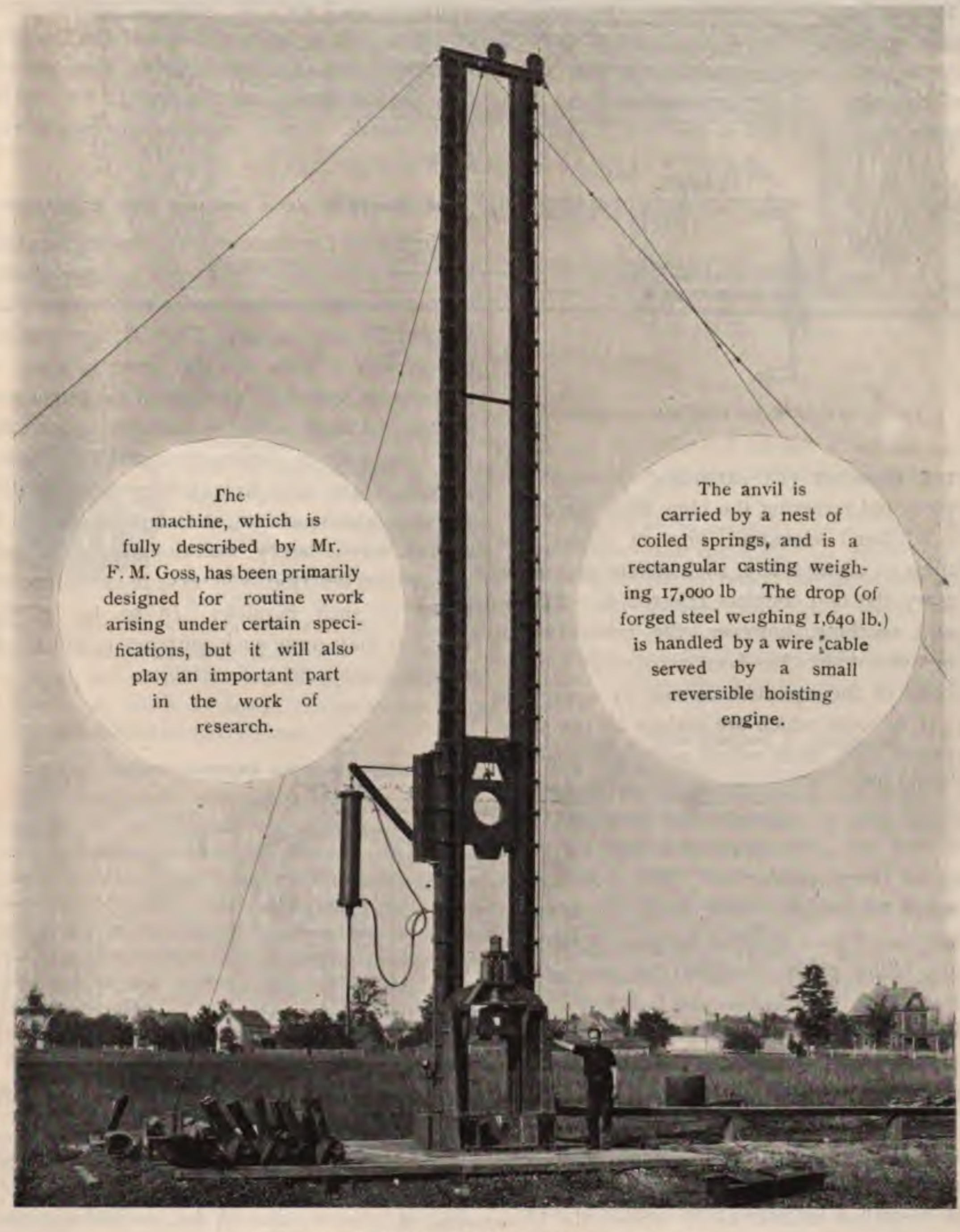
The vertical guides are shown in enlarged section by fig. 3. Each guide is made up of three rolled shapes, namely, a rail section, a channel, and an eye-beam, to which at intervals is added a curved brace to serve as a ladder. The height of the guides makes it necessary to have them guyed from the top as shown by fig. 1. Their lower portions are reinforced by cast-steel housing.

An air-hoist (D, fig. 1) serves in handling accessory equipment and the materials to be tested. The hoist is carried by a double-hinged crane in such a manner that it may be swung around to the centre line of the machine from either side. This is best shown in the plan (fig. 1).

TESTING UNDER THE DROP.

To test either the guard-arm or the knuckle of a coupler under buffing strains, the shank of the coupler is dropped into the steel-lined pocket (B) of the anvil, and the body of the coupler is wedged into position under the drop by means of steel liners supplied for that purpose. Thus prepared, the Master Car Builders' specifications require that the couplers shall withstand three blows from a height of five feet and three blows from a height of ten feet, delivered either upon the closed knuckle or upon the guardarm, without producing distortion beyond stated limits.

A tension ("jerk") test of couplers involves additional equipment, as shown upon a large scale by fig. 4. In this case the coupler is fitted to a suitable yoke (F) which in turn is



The machine, which is fully described by Mr. F. M. Goss, has been primarily designed for routine work arising under certain specifications, but it will also play an important part in the work of research.

The anvil is carried by a nest of coiled springs, and is a rectangular casting weighing 17,000 lb The drop (of forged steel weighing 1,640 lb.) is handled by a wire cable served by a small reversible hoisting engine.

MASTER CAR BUILDERS' DROP TESTING MACHINE,
Installed at Purdue University.

carried by springs performing the same function on the machine that is performed by the draft rigging on a car, the whole being suspended from a cross-girder surmounting two cast-steel columns. In the original machine two couplers were employed in this test, a suitably formed equaliser (E) extending between the couplers and receiving the blow from the drop. The left-hand elevation (fig. 1) shows the columns on either side of the machine necessary to carry the two couplers referred to. In the present machine, however, the necessity for using two couplers has been avoided by having one end of the equaliser carried by a support (fig. 4) beneath which are springs of the same character with those which carry the yoke on the other side. It is believed that in this manner the jerk test of couplers has been simplified and that for comparative purposes its value has not been diminished. The yoke F is designed to receive coupler shanks of different dimensions by an opening sufficiently large to admit filling pieces, designed for the several different-sized shanks.

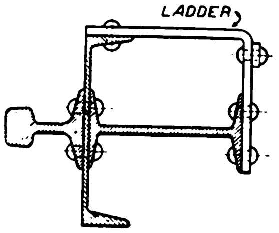


FIG. 3. SECTION OF VERTICAL GUIDES.

Draft-gears for test under the drop are fitted to short lengths of draft sills, the ends of which may rest directly upon the anvil of the machine. In the place of the usual yoke and coupler, dummy construction is employed which will give a shank reaching out between the draft sills in such a manner as to receive the blow of the drop. Tension tests of draft gears by use of this machine are not contemplated.

For axle testing there are provided two supports which may be placed upon the anvil on either side of the centre line of the machine to receive the axle, which, when thus placed, may receive blows from the drop in the middle of its length. Similar equipment serves in rail testing.

THE MACHINE AS A MEDIUM FOR RESEARCH.

The Master Car Builders' drop-testing machine has been brought into existence to serve chiefly in routine work arising under certain specifications of the Association. There is, however, no reason why it may not also serve in work of engineering research. In view of the important studies of a highly scientific character concerning the behaviour of constructive materials under impact, which have already been made by the aid of lighter machines, it is but reasonable to expect that a heavy, well-designed drop such as has been described will serve in extending the limits of such inquiries. In so far as the machine may serve such purposes it will fill an ever-increasing field of usefulness.

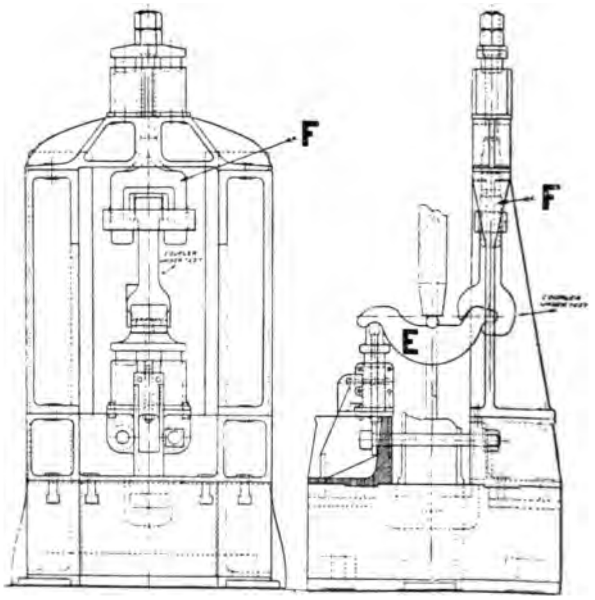


FIG. 4. EQUIPMENT FOR TENSION TESTS.

THE GAS ENGINE AND STEAM TURBINE IN HARNESS.

By B. H. Thwaite, C.E.

THE economic supremacy of the principle of centralisation in modern work of power-energy development, and the distribution and transmission of such power electrically, is now proved beyond cavil. We have had for many years evidence of the economic effect of concentration in the high-power ocean steam-ship plants, and engineers only awaited the advent of an economic method of transmission of power to accept the economics of the principle of centralisation on land.

THE PRIME MOVERS OF THE FUTURE.

We have already evidence of the economy of the system of concentration in County-electro-power plants, instance that of Newcastle and district; and we have through the Mersey Electric Railway results, additional evidence to that already accumulated in favour of the displacement of the small-power railway locomotives, by the system of centralised power production, and its electrical distribution. There is little question but that we are on the eve of a great revolution in railway transport methods, and this may mean the electrification of even our great trunk-railways. Now the margin of possible improvement in the modern electrical machinery of transformation and distribution has been gradually narrowed down, but there is still ample margin for improvement in the choice of the instruments of motive or dynamic energy production, and the battle of the future against inefficiency will probably be more or less localised within the area allotted to the reduction of the thermodynamic inefficiency of our prime movers. The struggle will probably still go on—one claiming the gas engine as the solution of thermal efficiency, and the other putting forward the advantages of the steam turbine.

It may here be mentioned as a peculiar historic coincidence, that the engine by which the author obtained the thermal results that led to the harnessing of the blast furnace to the gas engine, and as a sequential incident, the creation of the high-power gas engine, was built at the works from which the Parsons turbine was launched into the commercial world.*

GAS ENGINE *V.* TURBINE.

Now the adherents to the cause of the gas engine make the following incontestable claims :—

- A proved thermal efficiency on every-day work of some 30 per cent.
- The economic facility for recovering the nitrogen and tarry compounds from the fuel.
- Low water consumption.
- Less liability to dangerous explosions than is associated with steam boiler installations.
- Less labour requirements.
- A possible mechanical efficiency of 85–90 per cent. with balanced-effort vertical types of engines.
- A possible running regularity with multiple vertically-arranged cylinders that will satisfy the cyclical exigencies of polyphasic and parallel-running electrical machinery.

The adherents to the cause of the steam turbine claim—first, an almost perfect cyclical regularity, and one that is unapproachable with a reciprocating engine, however well balanced it may be; secondly, a higher power of output ratio to weight of machinery; thirdly, self-starting. The adherents to both power systems will secure victories. In Germany, for example, we find that the Frankfort Electrical Station is equipped with steam turbines of high power, whereas in other parts of that country very high-power capacity gas engines are in regular use, and to-day many are endeavouring to embody the cyclical advantages of the steam turbine with the thermal efficiency of the reciprocating gas engine in a new machine. Unfortunately, it is possible that the active workers in this new development are overlooking the great fact explaining the high-power gas engine success—the reliance which can be placed on mechanical, and of course controllable means to secure such a density of a gaseous explosive mixture (constituted of gas of low calorific value of only some 80 to 100 B.Th.U. per cubic foot) as will ignite with the rapidity necessary to satisfy the high reciprocation of gas engine practice, and this without danger of pre-ignition during the active period of compression. Of course such a gas is almost incapable of ignition at normal atmospheric pressures, and consequently requires a compression application of some four to six atmospheres to make it adequately sensitive to ignition influences. In modern practice the tendency is even towards higher and higher degrees of compression. This high-compression stage is the secret of the thermal success of the Otto cycle, and it is this feature that will constitute the difficulty in producing a thermally efficient and commercially satisfactory gas turbine, because if high thermal economy is to be attained there must be no unavoidable dissipation of thermal energy in compression effort.

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* The works of Messrs. Clarke, Chapman and Co., Gateshead.

CONDITIONS INIMICAL TO A GAS TURBINE.

The minimum loss in the compressional stage is secured in the ordinary Otto cycle because the compression work is effected in the power-developing cylinder. That this effort involves the minimum degree of loss can be readily ascertained in any well-constructed engine employing high degrees of compression. It will be found that the curve line of compression and that of re-expansion are almost line on line, that of expansion on the return stroke being only slightly below that of the line of compression, representing on the card area probably at the most only a few percentages of dissipated energy. Anyone who has studied the technics of compression realises the considerable loss in the flow of the compressed fluid through contracted areas such as the ports and other connections of the compression cylinder, *i.e.*, when the expansion is effected in a secondary cylinder, so that unless such compensation in the nature of higher-power potential ratios to weight of actuating organs can be obtained as will justify the loss of energy in compression work, it will be found to be irrational to deviate from the ordinary Otto reciprocating cycle, and it is therefore very probable that the high-compression stage efficiency provided by the Otto cycle will prevent the displacement of this latter reciprocating cycle by the turbine gas engine, or even by the engines of the two-cycle principles or in which compression and expansion are effected in two distinctive cylinders.

No turbine air compressors working at variable speeds are likely to give such a sustained return of power energy as is given by the reciprocating Otto cycle engine, and without this high initial compressional stage the turbine as representing a thermally economic principle will be unavailable, at least for using the ideal power-gas of the future, or one in which carbon monoxide is the supreme agent of heat production, and in the use of which a high degree of compression is necessary to secure a sufficiently sensitive ignition. If a turbine gas engine is to be economic, its fuel agent must be a gas that will be ignitably sensitive with comparatively low degrees of pre-compression, such as is oil vapour or a gas rich in hydrocarbons; but then this condition brings with it the difficulty of a higher range of temperature in the working cylinder, and the danger of the overheating of the actuating organs of the engine.

PROPOSED DUAL COMBINATION OF GAS ENGINE AND STEAM TURBINE.

But if we admit that the practical construction of a thermally economic gas turbine appears to be almost unattainable, there is surely no reason why the two power-producing agents—the gas engine and the steam turbine—should not work in harness together. Some years have passed since Mr. Dugald Clerk and the author jointly considered it to be practicable to build a 1,000 h.p. gas engine for marine purposes; since then, very great progress has been made in the construction of internal-combustion reciprocating engines of high power. If one were asked to formulate a proposition for a power plant of high-power capacity, especially for marine applications, but applicable for land services, it would certainly include a programme of interdependence, in which the power creators would be a gas engine and a steam turbine. And why? Because in the gasification of the fuel, and in its preparation for the gas engine, it is primarily essential that the gas shall be cooled to the temperature of the atmosphere, and the loss of the sensible heat this temperature reduction involves, might be prevented if part of the gaseous fuel were employed for generating steam; the combustion of the gaseous fuel being effected in the steam boiler furnace with air heated by being drawn through the gas tubular cooling apparatus. Moreover, it is essential that the working cylinders of the (Otto cycle) gas engine and some of the actuating organs should be kept cool, an operation involving a considerable loss of thermal energy, even as much as that thermo-dynamically utilised. Now, a great proportion of this thermal waste could be avoided if an auxiliary steam generator were made part of the power equipment. Besides, the exhaust gases of the gas engine are available as an additional source of heat supply. The steam thus generated would be available for driving a steam turbine, so that the two types of power-generating machines would be acting in inter-dependent connection for a common service. The absolutely perfect combustion of the gaseous fuel in the working cylinder of the gas engine would provide a great part of the thermal potential required for driving the steam turbine; the gasification process and the gas engine exhaust stages would be drawn upon to secure part of the balance of heat, the remaining thermal requirement being satisfied by direct combustion of the gaseous fuel in the steam boiler furnace.

The steam turbine and its steam-generating accessories would provide an independent auxiliary plant to serve as the starting equipment for the vertical gas engine, and the reversal motion requirements would also be obtainable from such an elastic combination. The operating programme of such an interdependent turbine and gas-engine equipment will be made up as follows: The rapid starting of the gasification process with fan propeller, driven with steam initially generated with solid fuel to be subsequently displaced with gas; the starting of the high-power vertical gas engines with the steam turbine; the reversal of the gas engines by the steam turbine, which will, of course, be compounded and equipped with condensers; the proportion of the gasification product required to be used in the steam generator will be small because of the thermal assistance given by the gas engine, hot jacket water, etc.

The proposed dual combination of prime movers would give the following advantages to ocean steamships:—

First, it would reduce the thermal loss by at least[*] $\frac{4}{10}$ by ·100=40 per cent., without allowing for the heat saved by the utilisation of the hot jacket water, which might secure a further saving of 15 per cent., making up a total thermal saving of 55 per cent. on the best existing marine engine practice.

THE COMBINATION AS AFFECTING BATTLESHIPS.

The other advantages that may be enumerated would mean a lessened consumption of water. The tell-tale trail of smoke issuing from the funnels of steamships would practically disappear, adding thus to the comfort and cleanliness of the ship, besides reducing the danger in war time of capture by the enemies or by privateering vessels. The advantages would be extended, if the propositions were applied to a battle-ship, by other features of strategic value. For instance, during an engagement the steam-generating plant could be shut down altogether, and there would be no danger of self-destruction should the steam boilers be pierced with shot or shell. The trail of smoke and its indication of the vessel's movements would be absent, and the piercing of the funnels (of small proportion compared to those of existing practice) would not interfere with the efficiency of the gas engines. The fuel would be fed into the high-pressure gas generators automatically, so that the stokers' work in the boiler stoke-hole of a battle-ship would be deprived of its terrors, and, owing to the reduction in weight of fuel required for a given power, the storage space would represent a more extended running power. A like proposition for inland services would permit smokeless power to be obtained, and with bituminous fuel, the recovery of the condensable hydrocarbon and nitrogen as well, the programme of operations need involve only a very temporary service of solid fuel.

For the purpose of securing mechanical efficiency, the more closely the line of the curve of power developed by combustion in the cylinder of the gas engine correlates with the effective crank-turning moment line, the higher is the attainment of mechanical efficiency. A violent development of power almost on the line of the dead-crank centre is inimical to the mechanical and sustained working efficiency of the gas engine. The completeness of the diagnosis of the efficiency of a gas engine is limited by the character of our testing instruments of precision, and until the question of the variability of the specific heat with rise of temperature as the explanaion of the limitation of temperature of gaseous combustion is either accepted or disproved, and until an instrument as reliable as a modern pressure indicator can be found to directly determine temperature variations during the acting stroke of a gas engine, it is impossible, with any practical advantage, to discuss what is termed the entropy character of a gas engine.

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[*] 12 per cent. is taken as the representative thermal efficiency of a high-class steam engine.

THE UNDERTYPE ENGINE.

BY J. C. R. ADAMS.

(Continued from page 32.)

The present series, which is now concluded, commenced in PAGE'S WEEKLY for December 23rd. Previous articles on Portable Engines, by the same author, appeared in the July-October numbers of PAGE'S MAGAZINE.

MESSRS. CLAYTON AND SHUTTLEWORTH, LTD., of Lincoln, show, in fig. 11, one of their latest and most up-to-date designs in the way of compound undertype engines for working at 150 lb. boiler pressure. We have again the almost universal outside steam chests, steel-girder frame, cylindrical guides, centre bearing to crankshaft (except in the smallest sizes), and in engines of 16 n.h.p. and upwards, an outside bearing also.

The automatic expansion gear is of the link type, controlled by the inverted arm Hartnell governor. In short, the engine is built to first-class specification, to a design which appears to have commended itself to nearly all the leading makers, and, with Messrs. Clayton

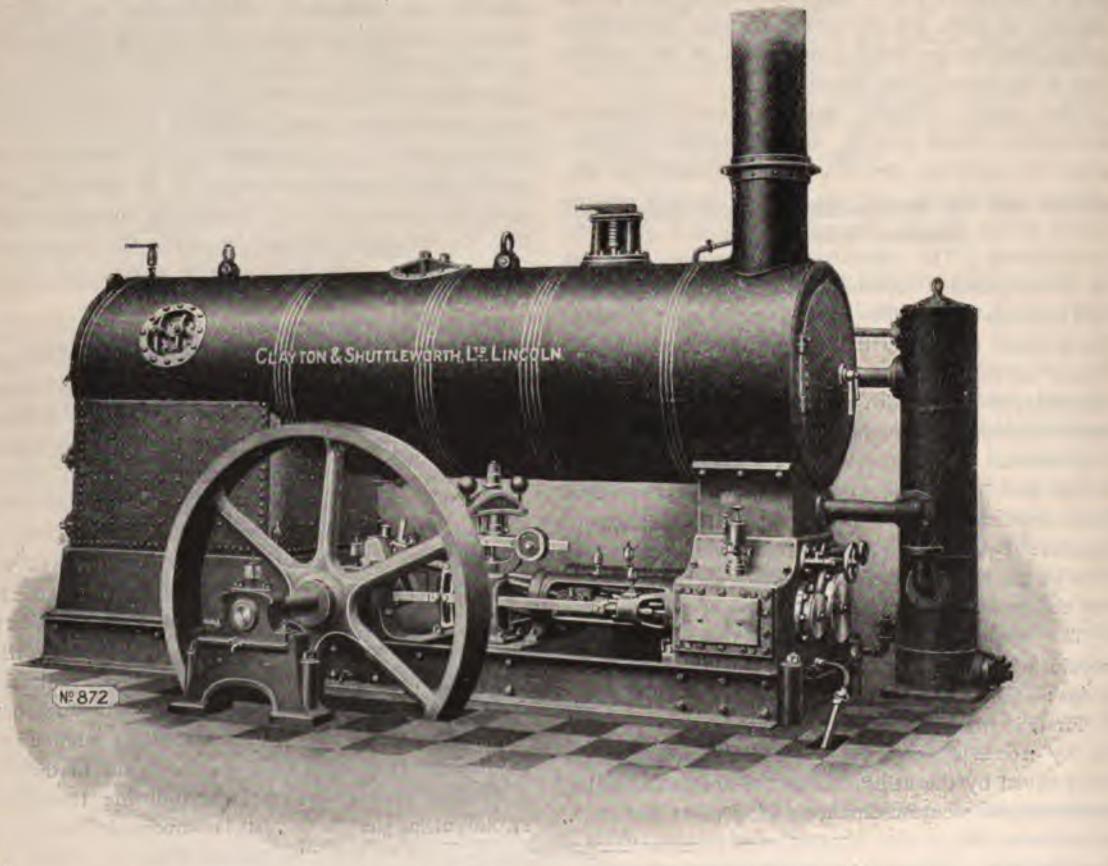

FIG. 11. COMPOUND UNDERTYPE ENGINE BY MESSRS. CLAYTON AND SHUTTLEWORTH, LTD., FOR 150-LB. BOILER PRESSURE.

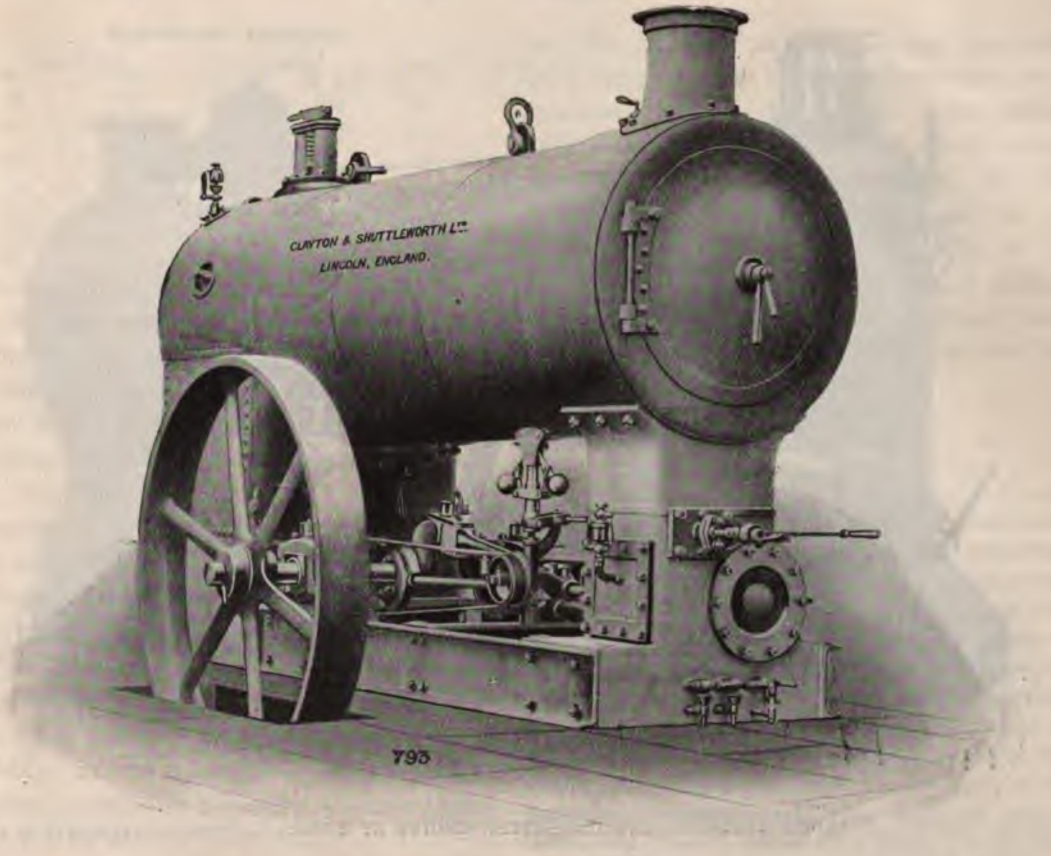

FIG. 12. MESSRS. CLAYTON'S SINGLE-CYLINDER HIGH-PRESSURE UNDERTYPE ENGINE.

and Shuttleworth's well-known workmanship, we confess that it would be difficult to suggest anything in the way of improvement, except, perhaps, in the balancing of the cranks.

The vertical water-heater, shown in fig. 11, is not, we believe, included in the outfit, but is, nevertheless, an adjunct which should form a part of every installation where the utmost economy is studied.

Where there is a good supply of water available, Messrs. Clayton, in common with other makers, are prepared to supply condensers, either of the jet or the surface type, the latter being specially applicable where salt or impure water forms the condensing medium.

Messrs. Clayton's single-cylinder and double-cylinder high-pressure undertype engines are shown in figs. 12 and 13.

No detailed description of either is necessary, as the engravings are exceptionally clear. Messrs. Clayton's dimensions are as under, the cylinder ratio in compounds being 2·6 to 1 :—

SINGLE AND DOUBLE-CYLINDER ENGINES.

Horse Power.		Cylinder.		Revs.
Noml.	Effective.	Dia.	Stroke.	per Min.
6	15–18	8½	12	140
8	20–25	10	12	140
10	25–30	11	14	130
12	30–36	12	16	120
		DOUBLE CYLINDERS.		
10	25–30	7¾	12	140
12	30–36	8½	12	127
14	35–42	9	14	127
16	40–48	10	14	127
20	50–60	11	14	116
25	63–75	12¼	16	116
30	75–90	13	18	100

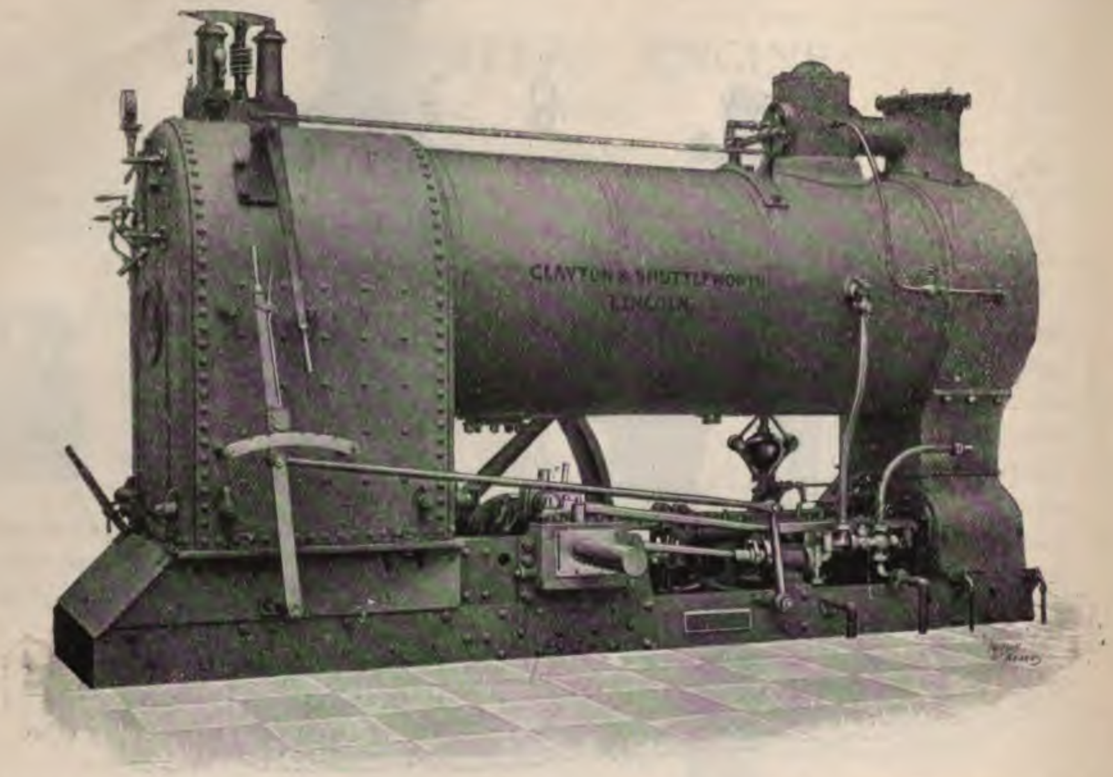

FIG. 13. DOUBLE-CYLINDER HIGH-PRESSURE UNDERTYPE ENGINE BY MESSRS. CLAYTON AND SHUTTLEWORTH.

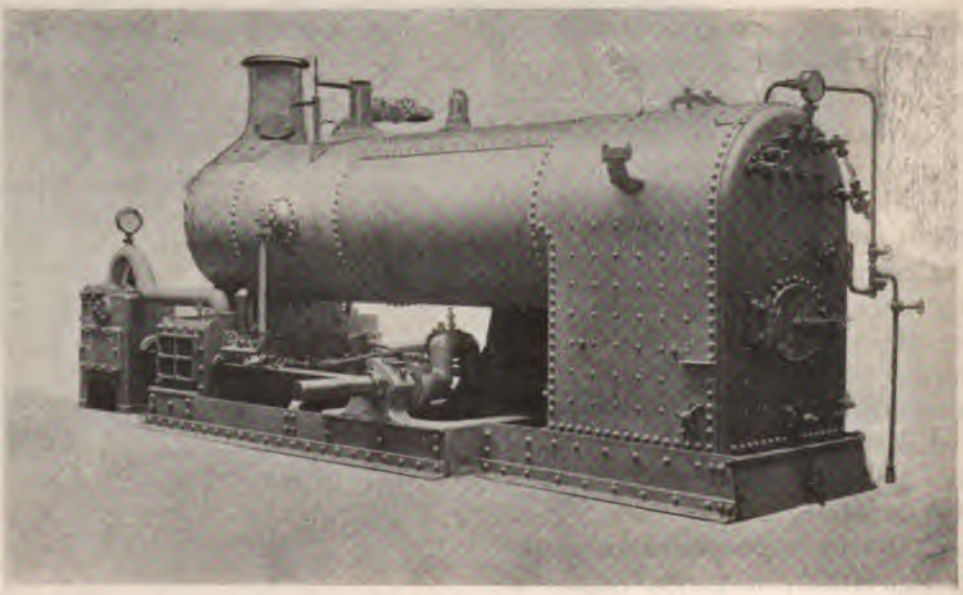

FIG. 14. 16-N.H.P. COMPOUND UNDERTYPE ENGINE BY MESSRS. E. R. AND F. TURNER, LTD.

COMPOUND ENGINES.

Horse Power.		Cylinder.		Revs.
Noml.	Effective.	Dia. H.P.	Dia. L. P.	per Min.
10	25–30	6¼	10¼	172
12	30–56	6⅞	11¼	172
16	40–48	8	13	150
20	50–60	9	14½	150
25	63–75	10	16¼	133
30	75–90	11	17¾	133

Messrs. E. R. and F. Turner, Ltd., of Ipswich, have favoured us with a photo of their 16 n.h.p. compound undertype engine, the boiler being left unlagged to show the riveting. This particular engine is fitted with condenser, which, of course, is not a part of the regular outfit. The Turner-Hartnell governor controls the admission in the high-pressure cylinder, and there are many other interesting features, such as the single flat guide bar, diagonal bearings, three in number, to the crankshaft (which is bent out of a round steel bar) and the feed-pump, driven by the low-pressure main eccentric rod. (Fig. 14.)

Messrs. Turner make these engines in the following sizes, the average cylinder ratio being a little over 2½ to 1 :—

MESSRS. TURNER'S COMPOUND.

Horse Power.		Cylinders.			Revs.
Noml.	Indicated. (Economical).	H.P.	L.P.	Stroke.	per Min.
12	38	7	11¼	12	180
16	50	8	12¾	14	155
20	63	9	14	16	135
25	78	10	16	18	120

In concluding this brief survey of the leading types in this class of engine, we are struck by the fact that, except in minor and unimportant details, the examples we have noticed are, to use a familiar phrase, "as alike as two peas." If we except Messrs. Turner's engine, which contains some original features, there is hardly sufficient difference between any of them for their own makers to recognise them apart, in the absence of the name-plate. Is this due to want of enterprise, or lack of originality, or is it not rather a convincing proof that in its thirty years' existence, the comparatively short-stroke, quick speed, double-cranked compound —whether surmounted by a boiler or not, is, for the moment, immaterial—has gradually been refined down by natural selection, to a common standard, the survival of the fittest, to which, it cannot be doubted, every manufacturer has contributed something. Be this as it may, there is no mistake about the resultant of all these efforts. We have in the undertype engine of to-day, a typical product of British brains and energy, of which those who have laboured in its cause may well be proud.

OBITUARY.

Mr. Beauchamp Tower had won a considerable reputation among engineers, and the news of his death at the early age of 59 has been received with general regret. He was a member of the Institution of Civil Engineers, Naval Architects and Mechanical Engineers. From the year 1870 onwards, Mr. Beauchamp Tower was associated with Mr. Froude in the experiments made with the object of improving the design of warships, and, indeed, the apparatus employed was mainly designed by him. He also engaged in independent investigations in other fields of applied science and designed, among other things, the spherical steam engine, a centrifugal pump revolution indicator and a gyroscopic steady platform for guns at sea. He will also be remembered for his experiments in connection with friction, the results of which are recorded in the Transactions of the Institution of Mechanical Engineers.

Mr. Frederick Elkington, who died last week at the age of 78, was the eldest son of Mr. George Richard Elkington, the patentee of electro-plating, and had himself played no small part in the elevation of the art of the silversmith. Outside his commercial career Mr. Elkington was recognised in art circles as something of a connoisseur, and he made a noteworthy collection of Asiatic enamels.

Mr. Thomas Colling Davison was for forty years intimately connected with the iron trade of the Teeside district. He was a partner in the firm of C. E. Muller and Co. who have latterly been largely interested in the Swedish ore trade.

Mr. John Anderson, of Coatham, whose death took place last week, had been for the last half century connected with the blast furnaces of Messrs. Bolckow, Vaughan and Co.

LAUNCHES AND TRIAL TRIPS.

ADDITIONS TO THE NAVY.

The torpedo-boat destroyer *Ness*, built and engined by Messrs. J. S. White and Co., Ltd., of East and West Cowes, to the order of the Admiralty, was launched from the builders' yard last week. The *Ness* is 230 ft. long over all, and has a beam of 24 ft. and depth of 15 ft., and her design throughout is of the most modern type, known as the river class, with high-standing forecastle. She has twin-screws, and her engines, of the three-cylinder, triple-expansion, torpedo-boat type, will give revolutions of 350 per minute when she is going at her full speed of 25½ knots. She will have four boilers of the White-Forster type.

The torpedo-boat destroyer *Gala* was successfully launched from Messrs. Yarrow and Co.'s yard at Poplar on Saturday last.

The torpedo-boat destroyer *Ouse* was launched on Saturday last from the works of Cammell, Laird and Co., Ltd., Birkenhead.

A NEW TROOPSHIP.

The Indian Government troopship *Dufferin*, the largest ship in the world of this class, has completed her official trial. She attained a speed of 18·9 knots, nearly half a knot in excess of her contract speed. She was designed by Sir Edward J. Reed, K.C.B., and is 437 ft. long, with a 52 ft. 6 in. beam, and a displacement of 7,340 tons. She will accommodate 1,200 officers and troops, and has been designed for use as an armed cruiser. The *Dufferin* was built by Vickers, Sons and Maxim.

A BOOTH LINE STEAMSHIP.

Messrs. Workman, Clark, and Co., Ltd., of Belfast, launched on Tuesday from their yard a steamship built to the order of the Booth Steamship Company, (Ltd), of Liverpool. The new steamer, which was named the *Anselm*, is 400 ft. long, with a gross tonnage of 5,600. A large steel deckhouse extending the full length of the bridge deck will be fitted with commodious state-rooms, and altogether accommodation will be provided for 140 first-class passengers. The propelling machinery consists of a set of direct acting triple-expansion engines. The main boilers are of the single-ended cylindrical multitubular type. The vessel has been specially designed for the tourist and general passenger trade to North Brazil, and will run regularly in the service between Liverpool and Para and Manaos.

H.M.S. ARGUS.

H.M.S. *Argus*, built by Messrs. Bow, M'Lachlan and Co., Ltd., Paisley, has completed an exhaustive series of trials, comprising power, speed, anchor, steering, and gun-firing trials, as also stability tests, all of which were most successfully performed, the power and speed results achieved being in excess of contract requirements.

THE TYNE.

On Saturday last the screw-steamer *Rosemount*, built by the Northumberland Shipbuilding Company, Ltd., Howdon-on-Tyne, to the order of Messrs. John Cory and Sons, Ltd., Cardiff, for the Seville and United Kingdom Carrying Company, Ltd., left the Tyne for her trial trip. This vessel is the ninth built for the above firm, and is constructed to the highest class at Lloyd's, single deck, built under special survey. Her dimensions are 335 ft. over all, 48 ft. breadth extreme, and 24 ft. 3 in. moulded.

The machinery has been supplied by Messrs. Richardsons, Westgarth and Co., Ltd., Sunderland, with cylinders 23½ in., 39 in., and 64 in. by 42 in. stroke, and two large boilers 15 ft. diameter, by 10 ft. 6 in. long, with a working pressure of 160 lb. per square inch. The vessel is designed to carry 5,350 tons on a light draft. The trial trip proved in every way satisfactory, the machinery worked without a hitch, and a speed of 10 knots was easily obtained.

HARTLEPOOL.

The new steel-screw steamer *Germanic*, recently launched by Irvines Shipbuilding and Dry Docks Company, Ltd., West Hartlepool, and built to the order of Messrs. W. H. Cockerline and Co., Hull, proceeded to sea for her trial trip. She is of the following dimensions: 342 ft. by 49 ft. 6 in. by 25 ft. 2 in., and of a large measurement cargo capacity. The vessel is built to Lloyd's highest class under special survey, and is of the single-deck type, having poop bridge and top-gallant forecastle.

Engines of the triple-expansion type have been supplied and fitted by Messrs. Richardsons, Westgarth and Co., Ltd., Hartlepool, having cylinders 23½ in., 39 in. and 66 in. by 45 in., two S. E. boilers each 16 ft. by 10 ft. 6 in. working at a pressure of 180 lb. After adjusting the compasses a series of runs were made, and a mean speed of 11 knots was obtained, the engines working smoothly and well. The vessel then proceeded to Barry to load.

THE WEEK AMONG THE TECHNICAL SOCIETIES.

INSTITUTION OF CIVIL ENGINEERS.

SIR WILLIAM WHITE ON THE VISIT TO AMERICA.

At a meeting of this Institute on Tuesday last, Sir Guilford Molesworth, President, in the chair, Sir William White, K.C.B., Past-President, delivered an address on "The Visit to the United States and Canada." There was a large attendance of members, and among those present were: Lord Strathcona, who was elected an honorary member, Sir Geo. Bruce, and Mr. Alexander Siemens. The lecture, which was illustrated by numerous lantern slides, was listened to with considerable interest. It was repeated to a second audience on Wednesday afternoon. The following is an abstract of the lecture :—

For the first time in the history of the Institution a visit has been paid to America by a representative body of its members.

The first reception by the President, Council, and members of the American Society took place on September 13th. One notable feature of this memorable gathering was the appearance thereat of Mr. Charles Haswell, M. Inst. C.E., who is undoubtedly the "father" of living engineers. He is now in his 97th year and still possesses his full faculties. Mr. Haswell was the first engineer-in-chief of the United States Navy more than sixty years ago, and had personal knowledge of the *Clermont*, the first passenger steamer, built by Fulton. The visit to the New York district continued until the morning of September 19th, the arrangements including visits to a considerable number of important engineering works as well as excursions of the greatest interest. New York and the surrounding district constitute a great field for engineering operations of the most varied and important character. Indeed, it may be said with propriety that, but for the work of the civil engineer, New York could not have become the great and growing city which it is. Unless engineers had provided means for rapid transit—bridges, tunnels, road and railway communications, deep water approaches to the harbour, berths and warehouse for shipping, the wonderful developments in "Greater New York" during recent years could never have been made.

The Rapid Transit Subway was the first among many great works, now in progress in New York, visited.

The demands for transit increase so rapidly that one hears confident expressions of opinion by competent authorities that, before the subway is entirely completed, it will be necessary to begin preparations for another, and so extend to other portions of the city the triple provision of elevated railway, street tramway and subway.

NEW YORK AND CITY DISTRICT.

The electric generating station connected with the subway is placed on the North River between 58th and 59th streets, and was opened for inspection. When completed it is claimed that it will be capable of producing more power than any electrical plant in the world.

In close connection with the question of rapid transit stands the construction of high buildings, which originated in Chicago, and are becoming general in New York and other great cities of America. The party had the privilege, not merely of seeing many completed buildings, but of inspecting some of the largest size while they were in process of construction. This opportunity was the more valuable, having regard to the growing adoption in this country of steel structures for building purposes. It is satisfactory to note one fact : in the production of special sections of steel joists and girders suitable for such buildings, our most recently designed steel works compare favourably with the United states.

Since the constitution of Greater New York the necessity for improved means of communication between Manhattan and Long Islands has been more fully recognised, and steps have been taken to provide them. The Brooklyn Bridge has been open for nearly thirty years, and the daily average of passengers is reckoned at 350,000. The new Williamsburg Bridge, just completed, is like the Brooklyn a suspension bridge, "double-decked," with deep girders between the the two platforms.

The Manhattan Bridge, now building, is situated between the Brooklyn and Williamsburg Bridges. It will be a suspension bridge, the total length (with approaches) being nearly 10,000 ft., and the main span nearly 1,500 ft. Another bridge is in progress—the Blackwell's Island Bridge—further to the north. The span over the main channel will be nearly 1,200 ft., that over the other channel nearly 1,000 ft., and that across Blackwell's Island over 600 ft. There will be six piers, two on Blackwell's Island, and two on each [illegible] millions of passengers [illegible] millions carried.

[illegible]

BROOKLYN NAVAL YARD.

[illegible]

THE CANADIAN TOUR.

[illegible]

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product. It is said that within a few miles of Ottawa there is 200,000 h.p. of water-power, and within a radius of 45 miles nearly a million horse-power.

UTILISATION OF WATER POWER.

Outside Quebec, at the famous falls of Montmorency, is a very interesting electric generating station. The falls are nearly 270 ft. in height; the head utilised being 200 ft. Five turbines are installed each of 1,000 h.p., and the current is employed in electric traction on the Quebec Railway and for lighting.

Then there are the Shawingan Falls (near Montreal). The falls are about 150 ft. high, and the water-power is estimated to be sufficient to produce upwards of 100,000 h.p. Here water is taken out of the river by a canal 1,100 ft. long, 100 ft. wide, and 20 ft. deep. In the power-house there are installed three pairs of inward-discharge turbines, each pair (at 180 revolutions per minute) being capable of delivering 6,000 h.p. A fourth unit was being installed, and will be capable of delivering 10,500-h.p. The electric energy is utilised in factories from 2 to 20 miles distant, and in Montreal 85 miles away. At the latter city 6,000 h.p. are now being delivered at a pressure of 50,000 volts. Amongst the industries obtaining power from these falls are electric lighting and traction, the manufacture of calcium carbide and ferro-manganese, and pulp mills; linen mills are to follow. Within four years of the time when the Shawingan Falls were accessible only by canoe, they have been thus utilised.

The visit to Niagara was made on September 27th. Apart from the electric installations (which have been described in PAGE'S WEEKLY), numerous and interesting engineering problems are involved in the works at Niagara. Great difficulties had to be faced in making the coffer-dams required for the construction of the head-works. The rapid and turbulent stream and the nature of the river bottom were the principal causes of difficulty, and they were overcome only by perseverance and large expenditure. It was necessary also to provide protection against floating ice, logs, and other solid objects. Careful screening of the intakes was essential, as well as arrangements for deflecting the current and regulating the velocity of flow. At the head-works of the Electrical Development Company, a large area of the river-bed was laid bare, and one could see how curiously the flow of water in the rapids had eroded the rocky bottom.

Two of the three great undertakings on the Canadian side are practically due to American capital and enterprise—a fact which does not redound to British credit, having regard to the enormous amount of British capital available for investment. The third company is distinctively Canadian, and is closely associated with Toronto.

THE ILLINOIS TUNNELS.

Two days were a ridiculously inadequate time to devote to such a city as Chicago, having regard to its special features as well as the great manufacturing and engineering works, which were freely opened for inspection. All that could possibly be done under the circumstances was done.

Members interested in bridge construction were taken on steamers to inspect many different types spanning the river, and had the opportunity of contrasting ordinary swing bridges with island piers in the centre of the channel, with the Waddell Lift Bridge, which can be bodily raised 155 ft. above the water, and with rolling bascule bridges, which have now been generally adopted and have great advantages in leaving clear the whole width of the channel. A large example of the last type was in process of erection, and its interesting details and mechanisms were visible. Others visited electric generating stations, and saw in actual work some of the largest steam turbines of the Curtis type yet made. Probably the most interesting of all these visits was that paid to the central station and tunnels of the Illinois Tunnel Company. This extraordinary enterprise is now far advanced towards completion, after many years work and great expenditure—said to reach four millions sterling. It had a modest beginning. The first concessions were granted for accommodating telephone cables, in connection with a novel system which provides for each subscriber being able to put himself in communication with any other subscriber, without the intervention of attendants at the Central Telephone Exchange. This system is now in operation. The promoters afterwards came to the conclusion that the system of subways might be used for the handling of freight by electric traction, as well as for telephone cables, and they have given effect to that idea on an enormous scale. Subways of small sectional area have been formed, at a moderate depth below the surface, under all the principal streets of the business quarters, and equipped for electric traction. By this means it is hoped that overcrowded thoroughfares, along which stand the high buildings used as offices, warehouses, and stores, will be relieved of the heavier traffic and freight. The visitors were taken through miles of these tunnels and their sidings, finally emerging on the lake front, where a great scheme of reclamation is in progress, and a public park is to be formed. The tunnel scheme has been worked out with thoroughness and skill; it provides for underground stations and sidings at the great railway termini, and in the basements of warehouses and stores. Local conditions of subsoil have favoured the construction of these tunnels, and reduced outlay, but they undoubtedly constitute a great engineering undertaking.

The South Chicago Works of the Illinois Steel Company were also visited. This is one of three establishments belonging to the company, which has a capital of seven millions sterling and employs 10,000 men. The works at South Chicago cover more than 300 acres, and include the largest rolling mill in the world. All departments of iron and steel manufacture are represented, the equipment is of the most modern type, and the output is extremely large. One of the most interesting features was the powerful plant operated by electric power, used for rapidly discharging cargo from steamers lying at the wharves immense weights of iron ore, and for transporting this ore to the great blast furnaces situated within easy reach of the stores of iron ore and the wharves. The resultant economy in cost of transport which accompanies increased dimensions in steamships has not been overlooked on the lakes, and the last few years have witnessed enormous developments, vessels being now employed which can carry upwards of 10,000 tons of dead weight.

CHICAGO DRAINAGE CANAL.

A good many of the visitors inspected the Chicago drainage canal. This canal, although designed primarily for sanitary purposes, is now regarded as part of a grand scheme for a deep waterway from Lake Michigan to the Mississippi river. It is pointed out that the work is easy of accomplishment because of the existence of the sanitary canal; that the people of Chicago have already expended almost 43 million dollars on their sanitary canal, and will have to spend 55 million dollars on the completion, whereas the estimated cost for the entire remainder of the work does not exceed 27 million dollars. The volume of water which will be carried by the canal when completed is designed to be 600,000 cubic ft. per minute.

The visitors had an opportunity of inspecting the ingenious controlling arrangements which have been constructed at the southern end of the canal, and seeing the "bear-trap" dam worked. There are seven sluice gates of metal with masonry bulkheads, each having an opening 30 ft. in width, with a vertical play of 20 ft. The bear trap dam has an opening of 160 ft. and a vertical oscillation of 17 ft. This dam consists of two great metal leaves hinged together and working between masonry bulkheads. The downstream leaf is securely hinged to the foundation, and the raising or lowering of the dam is accomplished by the admission or discharge of water through regulating valves. It will be seen from a comparison of this canal, with other existing ship-canals, that the people of Chicago have given another proof of their enterprise and courage in having undertaken and carried out this great work on a scale sufficient to make it form part of an inland channel for ships from the lakes to the Mississippi. The effect on the commerce of Chicago must be immense.

The party also visited the St. Louis International Engineering Congress.

CONCLUSION.

There can be no doubt but that this visit enabled American and Canadian engineers to give practical proof of their fellowship with British engineers. One effect of the visit, it is hoped, will be the extension of the membership of the parent Institution of Civil Engineers to many eminent American and Canadian engineers charged with the conduct of the great works incidental to the development of the resources and communications of that continent.

The development of the Dominion is in an early stage, but those charged with the responsibility of Government are fully alive to the grandeur of its resources and its potential greatness. The realisation of this policy largely depends upon the execution of engineering works of enormous magnitude. In Canada is to be found a splendid field for British enterprise and capital. Canadian engineers, without exception, expressed the hope that, in the organisation and conduct of the great works now contemplated or to be undertaken hereafter, they will have the assistance of British engineers, and especially of young engineers. No better school for aspirants in the profession can be found than that afforded by the Dominion. In these islands from the nature of the case, fewer and fewer opportunities for great engineering undertakings will present themselves; but in Canada one sees only the beginning of things, with immense possibilities in the immediate future. What is true of Canada is true also of our other colonies and dependencies, and it may be hoped that in the future British enterprise and British capital will be more largely devoted to the development of the resources of the British Empire, and less to corresponding work in foreign countries. Within its limits are to be found in profusion all natural riches, both vegetable and mineral, which are essential to the sustenance of the people, or as the raw materials of manufactures. In its manifold and varied sources of power, the command of labour, the number and generally prosperous condition of its population, the skill and experience of its industrial leaders and workers, the Empire as a whole is unrivalled. On all sides lie possibilities for development; and it is our duty to see that the great heritage which has come into our possession shall be enriched and consolidated. The "building-up" of the British Empire is the concern of all its citizens; not the peculiar task of statesmen. In this great undertaking it is certain that civil engineers must play a most important part, and that the influence of the Institution of Civil Engineers must be even greater in future than it has been in the past.

RUGBY ENGINEERING SOCIETY.

PATTERN MAKING.

At the meeting of this society, held on the 5th inst., a paper on this subject was read by Mr. R. Watson, of which the following is an abstract:—

Upon receiving a drawing in the pattern-shop, if the work is at all complicated it is set out full size, but in some cases sections only are required for the construction of the pattern and arrangement of cores. Machining allowances are shown. All the setting out is done to a contraction rule, so that any dimension which may be taken is the pattern size. The first thing which has to be done is to determine the best way of moulding the chief things, governing which are the principal machined surfaces; these are placed in the bottom of the mould to ensure their being clean and free from defects. Another point to be settled is the readiest way the cores can be put in the mould. Patterns should, in all cases where possible, be parted and dowelled together on the joint line of the mould, as in the case of a cylinder, through the centre line of the circle, so that when the top part of the moulding box is lifted off, the portion of the pattern covered by it is taken with it. Then the moulder can loosen each part separately and see what he is doing on drawing the pattern from the mould. Loose pieces, such as bosses and facings, cannot in all cases be avoided, and on permanent patterns these should be fixed on by a dovetail. One method of getting over the difficulty of several loose pieces is to put them all together in a core, but with dry sand work this often leaves a mark on the casting.

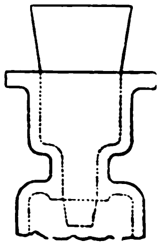

FIG. 1. SHOWING TAPER TO GIVE CLEARANCE.

In constructing large patterns wide pieces of timber should be avoided because of the shrinkage and expansion. Frames made of narrow pieces and half lapped together at the corners can often be used with advantage. Patterns made of dry timber will expand when left in the mould for any length of time and contract when stored away. Where possible the grain of the wood should run in the direction that the pattern is going to be drawn from the mould.

In large patterns, such as bedplates, good provision should be made for lifting as it adds considerably to the life of the pattern. Heavy standard patterns are often more damaged in lifting about than in actual use in the foundry.

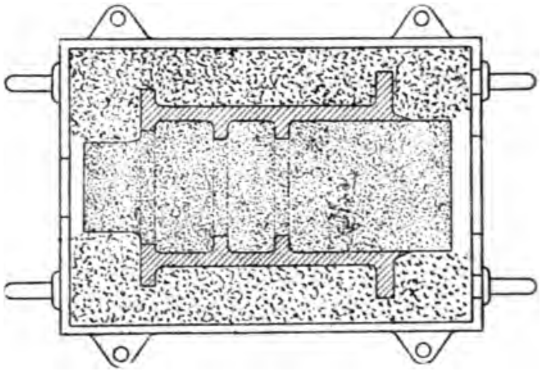

FIG. 2. SHOWING CHAMPHER TO PREVENT EDGE OF MOULD BREAKING DOWN.

The question of taper is often a very debatable subject between the pattern maker and moulder. There is no standard rule, each piece of work requires separate consideration. In most cases ⅛ in. to the foot is found to be sufficient, but on the inside of ribs and brackets where size is of little consequence more may be given. In prints where the core comes through the top moulding box for convenience of centring or releasing the core, etc., the size of the print is still kept the right size near the pattern, but tapered larger to give clearance for passing the core down as shown in fig. 1. No two prints on a pattern should be the same size, or nearly the same size, or probably the mould will be cored up wrong. In prints that mould horizontally the root should have a slight champher on it as shown in fig. 2, as this prevents the edge of the mould breaking down when the core is put in. If this is not done the moulder generally takes it off with his trowel each time he makes a mould.

Cores are often more difficult than the outside of the pattern; it often takes considerable time to arrange them so that they may be put in the mould in the readiest possible way.

In large cores allowance has to be made for expansion in drying to the extent of about $\frac{1}{16}$ in. to the foot.

Large cores where possible should be made the same way up as they are to be put into the mould, for convenience of getting at the iron to lift them by when fixing.

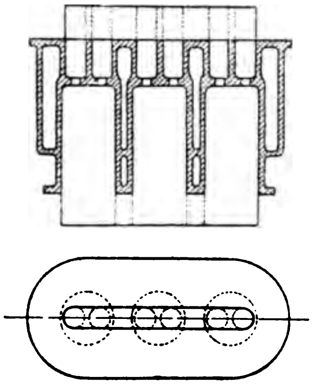

FIG 3. DOTTED LINES SHOW SEPARATE PRINTS AS COMMONLY MADE.

Where cores have to bore out to exact centres in relation to each other, as in the case of motor cylinders, where two or three boxes are in the same casting, these should be made in one core box tied togther by continuous prints at both ends as shown in fig. 3. This admits of a good stiff core-iron which can be readily broken without any risk of breaking the casting. In small cores, where great accuracy is required and where the metal is very thin, the core should be made about $\frac{1}{32}$ in. smaller in size than is required, to allow for blacking, and care must be taken that the cores fit their prints, for when once rubbing is commenced on the core, no two castings will be identical.

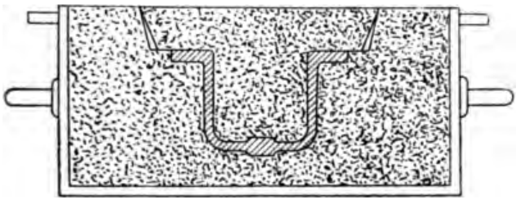

FIG. 4. THE CORE TAKES THE PLACE OF THE TOP MOULDING BOX.

Light castings such as covers, caps, cone-pulleys, etc., may be made so that the core takes the place of the top moulding-box and is self-centring, as shown in fig. 4. This core must be at least 1½ in. thick and 1 in. larger all round than the casting, so that it will bear sufficient weight being placed on it to withstand the lift while the mould is being poured.

One good method that is practised by some of the larger firms is to paint "black" parts that are not to be machined, "yellow" parts that are machined and "red" for prints and parts where the core cuts through the metal.

There is often a difference of opinion as to the right amount of contraction to allow on special large work and the following table shows a safe rule to work upon :—

General iron	$\frac{1}{120}$
Loam work cast vertically	$\frac{1}{200}$
Brass	$\frac{1}{64}$
Phos. bronze	$\frac{1}{100}$
Steel	$\frac{1}{48}$
Aluminium	$\frac{1}{74}$
Malleable iron	$\frac{1}{64}$
Lead	1

INSTITUTION OF CIVIL ENGINEERS.

YORKSHIRE STUDENTS' ASSOCIATION.

A meeting of the above Association was held on 5th inst., in the Law Institute, Leeds, the President Mr. E. Matheson, M.Inst.C.E., in the chair, when a paper was read by Mr. S. R. Kay, M.Inst.C.E., on "Considerations affecting the Design of a Viaduct as exemplified in the Conisborough Viaduct, to be built for the Dearne Valley Railway."

After explaining the position and nature of the railway and the conditions under which the River Don has to be crossed as Conisborough, Mr. Kay showed how the geological conditions and the near presence of colliery workings affected the choice of a suitable design. If an arched viaduct were to be built it would be necessary to purchase sufficient coal underneath to ensure stability, while in the case of a steel structure this would not be so important.

A useful formula for estimating the amount of coal to be bought to give safety from subsidence is

$$r = \frac{\sqrt{3d} \times \sqrt[3]{a}}{0{\cdot}8}$$

where r = radius of supporting pillar in yards.
d = depth of seam in yards.
a = thickness of seam in feet.

The most economical spans for different types of viaducts were found to be as follows :—

For brick arches	50–60 ft.
For steel girders erected on staging	100 ft.
For steel girders erected on ground and lifted into position	150 ft.

Having considered the various types it was finally decided to purchase the coal and build an arched viaduct. The viaduct will consist of 21 semi-circular brick arches of 55 ft. span, divided into three bays of seven each. These bays are separated by the river span and by a stop pier midway between the river and west abutment. The river span is of steel lattice girders 150 ft. span, with steel-plate flooring and weighs complete 310 tons. Total length of viaduct, 509 yards. Height above river 110 ft. The stresses allowed were 8 tons per square foot on brickwork at springings and 9 tons per square foot at bottom of piers. This was reduced to 3 tons per square foot on foundations for clay and marl, and 3·7 tons for hard gravel.

The viaduct will be faced with brindled bricks, in lime mortar for the upper portion and cement mortar below flood level. The piers are battered 1 in 36 The haunches will be filled with concrete covered with 1 in. of asphalt and fitted with drains.

The brickwork amounts to 23,000 cubic yards; excavation, 22,200 cubic yards; concrete (8 to 1), in foundations, 11,000 cubic yards; in haunches 3,900 cubic yards.

The difficulties of the site are increased by the fact that the only access to the site is by canal, the nature of the ground at each end precluding the use of contractor's lines overland. It is proposed to instal a cableway to deal with loads up to 3 tons. The paper was illustrated by diagrams.

An interesting discussion followed in which Messrs. Perkin, Rudyard, Lister, Matheson, and Miles took part. In the course of his remarks the latter gave the following rule for estimating the cost of brick viaducts of moderate height (40–80 ft.) for a double line of railway. The cost per yard run may be taken at £1 per foot of height. For each foot of height above 80 ft. add 1 per cent.

Mr. Kay having replied to the points raised in the discussion, the meeting closed.

BIRMINGHAM ASSOCIATION OF MECHANICAL ENGINEERS.

At a recent meeting of the Birmingham Association of Mechanical Engineers, Mr. W. Bardill read a paper on "Engineering Works' Policy and Modern Competition." The author pointed out the necessity of keeping machines running up to their full output, although admitting that even this stage might be reached and yet see a balance on the wrong side at the end of the year. Hence, the necessity for seeing that the work was yielding a fair margin of profit, which was, of course, the great problem. In these days of competition this could only be done by reducing the cost of production. Here was the great field for the engineer, where the fight of the future would have to be fought. Cheap labour, taking a broad view, was an absolute fallacy as a means towards reducing working expenses and a policy of slave-driving generally ended in failure. To get the best work out of a man he had to be made to feel happy and comfortable, to be fully trusted, to be made to feel that between himself and the employer there was a community of interests, and that he was a capable and intelligent part of the organisation. There were many ways of cutting down costs, such as the careful subdivision and supervision of departments and the introduction of the premium system or the piece system. Another point worthy of attention was the careful preparation of prime costs and the introduction of improved systems for the better working o the commercial part of the business. The American method of "firing the fools" and the riddance of obsolete tools could not be too strongly recommended, but the greatest help of all in cost reduction was the introduction of labour-saving appliances. The selection of staff had much to do with the success of a business, and a keen, sharp-witted foreman—one who knew the long and the short way of doing things—had more opportunities than anybody else of effecting reductions in cost. Under the chiefs of departments should be sub-foremen, chosen from the staff to encourage the others, so that every workman might feel that he had a chance of rising above trade union pay.

Mr. Bardill's paper produced an excellent discussion, contributed to by Mr. J. Batey, Mr. E. A. Dowson, Mr. R. B. Hodgson, Mr. M. Stanley, Mr. W. Deakin, Mr. J. Lord, Mr. W. H. Thornbery, and Mr. J. S. Orton.

The Efficiency of a Gasometer.

It would be interesting if someone would carry out an investigation as to the efficiency of a gasometer when new, and also when it has been in use for some years. There is no doubt that as time goes on the efficiency does fall off, indeed, in one case the writer has heard of, the pulling down of an old gasometer and installing a new one increased the dividends of a certain company from one and a-quarter to five per cent. It was found that the joints between the plates had opened by reason of the plates oxidising. M. Pretty, M.Sc., A.M.Inst.C.E., of Leicester, informs the writer of some investigations he has made on the subject which go to show the increased space occupied by the oxides and hydrated oxides of iron ranges from 40 to over 100 per cent., the latter being when there is a good deal of water with the oxide. Independently of any actual opening through which the gas can escape, it is probable that a certain amount of diffusion goes on through the oxide in the joints.

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts

CONTRACTS OPEN.

	Last Day.
Poole.—Construction of quay wall of ferro-concrete for Harbour Commissioners. Mr. H. F. J. Barnes, Towngate Street, Poole	Jan. 14
Bengal and North-Western Railway.—Supply of stores. Mr. Alex. Izat, Managing Director, 227, Gresham House, E.C.	Jan. 16
Manchester.—Supply of iron and steel-work, hydraulic tipping-rams and turn-table for elevated railway at Gaythorn station for Gas Committee. Mr. T. G. Newbigging, engineer, Rochdale Road Station...	Jan. 26
Southern Mahratta Railway.—Supply of steel materials, 600 pairs wheels and axles. Mr. E. Z. Thornton, Secretary, 46, Queen Anne's Gate, S.W.	Jan. 17
Bombay, Baroda and Central India Railway.—Supply of miscellaneous stores, in two contracts. Mr. T. W. Wood, Secretary, Gloucester House, Bishopsgate Street Without, E.C.	Jan. 17
Great Western Railway.—Extension of steel superstructure of Cricklade Road Bridge. Engineer, Paddington Station ...	Jan. 17
East Indian Railway.—Supply of spiral springs, cast-iron sleepers, and engine turntables. Mr. C. W. Young, Secretary, Nicholas Lane, London, E.C.	Jan. 18
Bamford.—Manufacture and supply of cast-iron pipes for a section of Derwent aqueduct for Derwent Valley Water Board. Mr. O. B. Steward, Bamford via Sheffield	Jan. 23
Grimsby.—Supply of plant and material for electrical department. Mr. W. A. Vignoles, Corporation Electricity Works, Grimsby (three specifications)	Jan. 23 Feb. 1
Swindon.—Supply and erection of Lancashire boiler with downtake superheater, etc., for Corporation. Mr. J. G. Griffin, Electricity Works, Swindon	Jan. 24
South Indian Railway.—Supply of 100 steel covered goods wagons, spoke wheels and axles and laminated bearing springs. Mr. Henry W. Notman, Managing Director, 55, Gracechurch Street, E.C	Jan. 24
Netherlands.—Supply of ironwork, soft steel, general ironware, corrugated galvanised soft steel sleepers, metal superstructures for bridges, etc.	Jan 25
Harrogate. — Supply and delivery of welded steel pipes and other materials in connection with the Masham Scheme Works; to be delivered at Ripley Station of the North-Eastern Railway. Mr. Edward Wilson Dixon, Engineer, Albert Street, Harrogate	Jan. 28
Ebbw Vale.—Construction of Carno reservoir (three contracts). Engineer, Mr. Geo. F. Deacon, 16, Great George Street, Westminster, S.W.	Jan. 31
Manuden.—Erection of an iron girder bridge at Common Mead, Manuden, Essex, for the Stanstead Rural District Council. Mr. Chas. Hicks, Surveyor, Stanstead, Essex	Feb. 1
South Shields. Execution of works and supply of plant in connection with the construction of overhead electric tramways. Mr. J. Moore Hayton, Town Clerk.	Feb. 20
Kirkcaldy.—An extension of about 500 ft. to present East Pier for the Town Council. Mr. Wm. L. Macendoc, Town Clerk ...	Feb. 4
Nottingham.—Construction of reservoir at Wilton Hill. Mr. F. W. Davies, Water Engineer, Water Offices, St. Peter's Square	Feb. 13
Lulea (Sweden).—Widening and deepening of the Channel, "Tjufholssundet," at Lulea. Harbour Commissioners, Lulea, will supply particulars	April 1

CONTRACTS CLOSED.

Tokyo.—Messrs. Dick, Kerr, and Co., Ltd., are now shipping 250 tons of electrical machinery, on their contract for the complete equipment of the Tokyo Denki Tetsudo Kabushiki Company's tramways. The system, when completed, will cover about 60 miles of line, and operate 250 cars.

Brazil.—The Brazilian Government has concluded a contract with Messrs. Siemens and Halske for the installation of two wireless telegraph stations—one on the island of Cobras, and the other on the cruiser *Riachuelo.*

Admiralty.—The contract for the electrical equipment of Malta Dockyard has been placed with the Lancashire Dynamo and Motor Company.

Liverpool.—The ventilating apparatus for the latest additions to the Cunard fleet have been supplied by a local firm, viz., Messrs. John Gibbs and Son, Duke Street, Liverpool. These ventilators have, for many years, been used by the Cunard Company.

Church Stretton.—The tender of W. Morley and Sons, of Keighley, has been accepted for sewerage work, price £7,578.

United States.—The contracts for the new United States battleship *New Hampshire* and the amoured cruisers *North Carolina* and *Montana* have been awarded. The *New Hampshire* will be built by the New York Shipbuilding Company, their bid being one of £749,600, the vessel to be completed in 38 months. The two armoured cruisers will be built by Newport News Company for £715,000 each.

Transvaal. — The Government have just placed through the Crown Agents a contract for a large quantity of fencing materials with the fencing department of Messrs. A. and J. Main and Co., Ltd., London and Glasgow, with urgent instructions for the promptest possible shipment to the colony.

France.—The London and Glasgow Engineering and Shipbuilding Company, Govan, have received an order from a French firm to build a passenger steamer of about 8,000 tons.

London County Council.—Messrs. W. C. Martin and Co., Glasgow and London, have just secured the order for the electric lighting of the thirty new steamers building for passenger traffic on the Thames for the London County Council.

Govan. – Messrs. M'Kie and Baxter, engineers and shipbuilders, Govan, have placed with Sir William Arrol and Co., Ltd., a contract for an extension which involves the doubling of the erecting and machine shops, the building of a new smithy, new pattern shop, store and finishing shop, and entirely new commercial and drawing offices at Govan.

Admiralty.—The Rivet and Bolt Company, Ltd., of Coatbridge, have received an order to supply 300 tons of rivets per week for a period of three years.

Cardiff. -- The Cardiff Town Council have placed orders for two 1,600-i.h.p. engines, with extras, with Messrs. Musgrave and Co., Bolton, and two 1,100-kilowatt generators with the General Electric Company, Birmingham.

Devonport.—Messrs. Graham Morton and Co., Ltd., of Leeds, have just obtained the contract for the supply delivery and erection, at the Electrical Generating Station at H.M. Dockyard, Devonport, of a complete coal-handling plant, including coal bunkers, stanchions, girders, flue, and coal measuring and weighing apparatus and all accessories appertaining to same. All materials used are to be of British manufacture throughout. It is but a short time since this firm received an extensive contract for the Admiralty, at Chatham Dockyard.

COMING CONTRACTS.

Kingswood.—An inquiry has been held into the application of the District Council to borrow £21,000 for sewerage works.

Bolton. Sanction has been obtained to borrow £65,459 for the extension of the Hacken sewerage works.

Bradford.—A proposal has been brought before the Town Council to spend £40,000 on electric lighting works.

Fife.—A committee has been appointed in connection with the proposal to construct a light railway from Falkland Road Station to Falkland burgh. The cost of carrying out the scheme is estimated at £10,500.

Gloucester.—The City Council have approved a scheme providing for the extension of the electric lighting at a cost of £15,000.

Russia. The Commercial and Industrial Gazette (St. Petersburg) states that, in view of the increased traffic, more especially military, along the Siberian Railway, the Ministry of Ways and Communications has decided to lay new rails along almost the whole extent of the line.

Switzerland.—The Feuille Fédérale Suisse of December 21st publishes a Decree granting M. R. Vontobel, of Winterthour, and M. Charles Probst, of Lucerne, a concession for the construction of a narrow-gauge electric railway from Meiringen to Gletsch. The total cost of the enterprise is estimated at 6,040,000 fr. (about £241,600) of which 490,000 fr. (about £19,600) is to be expended on rolling stock.

Finland.—The Finland Gazette states that the Director-General of Merchant Shipping in Finland is about to have several harbours of refuge constructed on the Baltic Coast. Provision has been made for these works in the latest Budget.

APPOINTMENTS VACANT.

	Last Day.
Carnegie Research Scholarships.—The Council of the Iron and Steel Institute will shortly proceed to award Research Scholarships founded by Mr. Andrew Carnegie. Candidates, who must be under 35 years of age, must apply on special forms to be obtained from Bennett H. Brough, Secretary, Iron and Steel Institute, 28, Victoria Street, London, S.W.	Feb. 28
Woolwich.—Supervisors at Royal Ordnance Factories. Salary £150 to £220. Particulars of the Chief Superintendent ...	—
Huddersfield.—Assistant lecturer in the Technical College. Salary £130. Particulars of Mr. Thomas Thorp, Secretary.	—
Bradford. — Second Assistant Electrical Engineer, Salary £250. Application to Mr. Fred Stevens, Town Clerk	Jan. 19
London.—Three Assistants, City and Guilds Central Technical College. Salaries £200, £150 and £150. Applications to Professor Ayrton, at the College Exhibition-road, London, S.W.	—
Bombay, Baroda, and Central India Railway.—Assistant electrical engineer. A five years' agreement at a salary of Rs.400 per calendar month. Mr. T. W. Wood, Secretary, Gloucester House, Bishopsgate Street, E.C. ...	Jan. 31
India Office.—A head draughtsman for the service of the Government of India. Salary Rs.350 per calendar month, rising to Rs. 500 per month. Particulars and forms of Director-General of Stores, India Office, Whitehall	—

APPOINTMENTS FILLED.

California.—Professor Harris J. Ryan has resigned his professorship in Sibley College, Cornell University, to accept a call to the head of the Department of Electrical Engineering of Stanford University, Palo Alto, Cal.

Blackburn. — Mr. Harold W. Seymour has been appointed car-shed superintendent of the Blackburn Corporation Tramways.

Worcester.—Mr. C. M. Shaw has been appointed City Electrical Engineer in succession to Mr. C. J. Sutherland, who is retiring owing to ill-health. Mr. Shaw has been filling the position of Electrical Engineer at Wakefield.

Wolverhampton.—Mr. Edward Raynes has been appointed convassing engineer and general commercial agent.

Belfast.—Mr. A. A. Blackburn, A.M.I.E.E., car-shed superintendent of the Manchester Corporation tramways, has been appointed to the position of car-works superintendent to the Belfast Corporation tramways, at a commencing salary of £300 per annum.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

The following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares business is being currently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our Share List will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from possible inaccuracies.

STOCK EXCHANGE SETTLING DAYS.—Settling days on the Stock Exchange are as follows:—

Consols: February 1st. General Settlements: January 13th, 27th, February 10th. Bank Rate, April 21st, 3 per cent.

I.—ENGINEERING, IRON, AND STEEL COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
11,270	5	5%	Alldays & Onions Pneumatic Engineering, Ltd.	3	2½— 3
10,000	5	3/-	Do. Cum. Pref. 6 per cent. ..	5	4½— 5
3,210,000	1	2/6	Armstrong (Sir W. G.), Whitworth and Co., Ltd.	1	3 3/16 — 3 5/16
76,970	5	2/-	Do. 4% Cum. Pref.. ..	5	5⅜— 5⅝
1,500,000	100	4%	Do. 4% 1st Mort. Dbs. Rd.	100	100 —102*
£100,000	100	4½%	Aveling and Porter, Ltd., 4½% Reg Mt. Debs. Red.	100	96 — 99*
580,000	1	1/7½	Babcock and Wilcox, Ltd., Ord. ..	1	3 5/16— 3 7/16
100,000	1	7½d.	Do. ,, 6% Cum. Pref.	1	1½— 1⅝
20,000	5	3/-	Baker (Joseph) and Sons, Ltd., 6% Cum. Pref...	5	5 — 5½
250,000	1	6⅜d.	Baldwins, Ltd., 5½% Cum. Pref. ..	1	1 — 1⅛
£250,000	Stk	4½%	Do. 1st Mt. 4½% Deb Stk Red.	100	101 —103*
150,000	4½	2/8⅔	Barrow Hæmatite Steel Co., Ld., O	4½	1 5/16 - 1 7/16
50,000	4½	6/-	Do. do. Cum 2nd. Pref.	4½	4¼— 4¾
33,334	5	2/6	Bayliss, Jones and Bayliss, Ltd., 5% Cum. Pref. Shares	5	4¾— 5¼
£500,000	100	—	Beardmore (Wm.) & Co., Ltd.. 4½% 1st Mt. Debs., Red., Scrip 50% pd	—	100 —102*
50,000	10	6/-	Bell Brothers, Ltd., 6% Cum. Pref.	10	11¾— 12¼
£366,600	Stk	4%	Do 4% Deb. Stock, Red.	100	98 —100*
149,850	1	6d.	Bengal Iron and Steel Ord.	1	1 — 1⅛
200,000	1	1/-	Beyer, Peacock and Co., Ltd., Ord.	1	19/32— 21/32
300,000	1	6⅜d.	Do. 5½% Cum Pref.	1	27/32— 29/32
£300,000	Stk	4¼%	Do. 4¼% Red. Deb. Stock	100	94 — 97*
1,629,760	1	6d.	Bolckow, Vaughan and Co., Ltd. O. Nos. 1-1,639,760	1	31/32— 1 1/32
1,860,900	1	3⅜d.	Do. Nos. 1,639,101-3,500 000	12/-	13/32— 15/32
1,160,000	1	4½d.	Brown (John) and Co., Lim., Ord., Nos. 1-1,160,000	15/-	1¼— 1⅜
590,000	1	6d.	Do. Ord., Nos. 1,160 001-1,750,000	1	1 25/32— 1 27/32
74,000	10	5/-	Do. 5 % Cum. Pref. ..	10	11 — 11¼
154,500	5	2/6	Cammell, Laird & Co., Ltd., Ord.	5	8¾— 9¼
232,500	5	2/6	Do. 5% Cum. Pref. ..	5	5⅛— 5¼
450,000	1	1/6	Clayton & Shuttleworth, Ltd., Ord.	1	31/32— 1 1/32
70,000	5	2/6	Do. 5% Cum. Pref	5	5¼ — 5½
£250,000	Stk	4%	Do 4% 1st Mort Db. Stk. Red	100	100 —102*
100,000	10	30/-	Consett Iron Co., Ltd., Ord.. ..	7½	32 — 34
75,000	1	2/6	Delta Metal, Ltd. Shares	1	1⅞— 2⅛
1,259,594	1	3⅜d.	Dorman, Long & Co., Ltd. ..	1	⅝— ¾
£400,000	Stk	4%	Do. 4% 1st Mort. Perp. Deb. Stk.	100	90 — 93*
£250,000	Stk	—	Do. 6% 2nd Mort. Deb Stk, Red.	—	94 — 96*
200,000	5	3/-	Dunderland Iron Ore Co., Ltd, 6% Cum. Pref. and Participating	5	2¼— 2¾
250,000	1	9⅜d.	Dunlop (James) & Co., Ltd., Ord...	1	9/16— 11/16
300,000	1	7½d	Do. 6% Cum. Pref. ..	1	13/16— 15/16*
4,721	13	12/-	Ebbw Vale Steel, Iron & Coal Co., Ltd.	13	9½— 10½
69,754	13	12/-	Do. do. do.	10	7⅞— 8⅛
20,250	10	8/-	Elliott's Metal, Ltd.	8	4½— 5½
5,000	10	5%	Do. Cum. Pref. 5% .. .	10	8¾— 9¼*
186,748	Stk	4%	Do. Deb. 4%	100	93 — 98*
25,000	10	6/-	Fairfield Shipbuilding & Engng.Co., Ltd., 6% Cum. Pref. ..	10	10¾— 11¼
£250,000	Stk	4½%	Do. 4½% Mort. Deb. Stk. Red.	100	99 —102
126,000	3	3/-	Fraser & Chalmers, Ltd., Ord. ..	3	4⅝— 4⅞*
21,000	3	1/6	Do. 7½% Cum. Pref.	3	5½— 6*
965,000	1	1/-	Guest, Keen & Nettlefolds, Ltd. Ord.	1	2 5/16— 2 7/16
344,000	5	2/6	Do. 5% Cum. Pref.	5	5⅝— 6⅛
£1,850,500	Stk	4%	Do. 4% Irred. Mort. Deb.Stk	100	103 —105*
13,000	5	2/6	Gwynnes, Ltd., 5% Cum. Pref. ..	5	2½ — 3½
250,000	1	1/-	Hadfield's Steel Foundry Co, Ld., Ord.	1	3⅜ — 3½
20,000	10	4/6	Do. 4½% Cum. Pref. ..	10	10½ 11
30,000	5	3/-	Hall (J. & E.), Ltd. 6% Cum. Pref..	5	5 — 5½
408,505	1	1/6	Harvey United Steel Co., Ltd. ..	1	1 5/16— 1 7/16
28,001	5	7/-	Head, Wrightson & Co., Ltd. ..	5	4½— 5
85,000	1	7½d.	Hill (Richard) & Co. (1899) Ld., Ord.	1	11/16— 13/16
18,000	5	3/-	Do. 6% Cum. Pref.	5	4½— 5
30,000	10	6/-	Hornsby (Richard) & Sons, Ld., Ord.	8	5¾— 6¼
750,000	1	6d.	Howard & Bullough, Ltd., Ord. ..	1	1 11/16 1 13/16*
25,000	10	6/-	Do. 6% Pref. (Non-Cum.) ..	10	12½— 13*
£250,000	Stk	4%	Do. 4% Deb. Stk., Red after 1905	100	97 —100*

ENGINEERING, IRON, AND STEEL COMPANIES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
37,500	10	20	Kynoch, Ltd.	10	18¾— 19¼
49,537	10	5%	Do. Cum. Pref. 5%	10	10⅜—10⅝*
300,000	1	4½d	Lambert Bros., Ltd., Ord.	1	⅝— ⅞
50,000	5	2/9	Do. 5½% Cum. Pref... ..	5	4 — 4½*
40,000	3	2/1½	Leeds Forge Co, 7% Cum. Pref. ..	3	3¾— 4¼
200,000	1	7½d.	Lysaght (John), Ltd., 6% Cum. Pf.	1	1 5/16— 1 7/16
£300,000	Stk	4½%	Do 4½% 1st Mt Deb. Stk., Red.	100	108 —110*
40,000	10	5/-	Mather & Platt, Ld., 5% Cum. Pref	10	11 — 11½
210,000	1	6d.	Measures Bros., Ltd, Ord.	1	⅝— ¾
75,000	1	6⅜d.	Do. 5½% Cum. Pref.	1	13/16— 15/16
£75,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk.,Red.	100	96 — 99
21,943	5	2/6	Muntz Metal, Ltd.	5	4¾— 5¼
14,248	5	5%	Do. Pref. 5%	5	4¾— 5¼
5,000	62½	47/6	Nantyglo and Blaina Iron Works, Ltd., 8% Cum. Pref.	62½	73 — 75
73,000	10	5/-	N. Brit. Loco. Co., Ltd., 5% Cm Pf.	10	11¾— 12
80,000	5	—	North-Eastern Steel Co., Ltd., Ord.	5	—
£250,000	Stk	4½%	Do. 4½% 1st Mt. Db. Stk.,Red.	100	90 — 93*
122,000	5	2/-	Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B"	5	3¾— 4
50,000	5	3/-	Do. 6% Cum. Pref. "A" ..	5	5¾— 6¼
70,000	10	6/-	Pease & Partners, Ltd., Ord. ..	10	9¾— 10¼
£400,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	97 —100
20,000	5	3/-	Peebles (Bruce) & Co., Ld, 6% Cm.P.	5	4¾— 5
230,000	1	—	Projectile Co. (1902), Ltd., Ord. ..	1	⅜— ⅝
126,938	5	2/-	Rhymney Iron Co., Ltd.	5	1⅞— 2
73,062	5	2/-	Do. New	5	1 11/16— 1 13/16
£330,000	—	5%	Do. 5% Mort. Deb., Red. ..	100	99 —102*
350,000	1	7½d.	Richardsons, Westgarth & Co., Ltd., 6% Cum. Pf. ..	1	15/16— 1
£350,000	Stk	4½%	Do. 4½% Perp. Deb. Stock ..	100	94 — 96*
35,000	10	12/-	Ruston, Proctor & Co., Ltd... ..	10	9¼— 9¾
275,000	1	6d.	Scott (Walter), Ltd, Ord.	1	13/16— 15/16
300,000	1	7½d.	Do. 6% Cum. Pref. ..	1	1— 1⅛
£300,000	Stk	4%	Do. 4% Perp. Deb. Stk	100	93 — 95*
£115,300	100	5%	Shelton Iron, Steel and Coal Co., Ld. 1st Charge 5% Debs.. Red ..	100	90 — 93*
£97,900	100	6%	Do. 6% 2nd Mort. Debs., Red.	100	91 — 95*
250,000	1	1/-	South Durham Steel & Iron, Ltd Or.	1	½— ⅝
300,000	1	—	Do. 6% Cum. Pref...	1	⅞— 15/16
£300,000	Stk	4½%	Do. 4½% Per. Deb. Stock	100	85 — 90*
25,000	10	—	Stephenson (Robert) & Co., Ltd., Or.	10	1½— 1¾
25,000	10	5/6	Do. 5½% Cum. Pref. ..	10	3½— 4
£250,000	Stk	4%	Do. 4% Perp Deb. Stock	100	76 — 78*
85,000	10	9/-	Stewarts & Lloyds, Ltd., Ord. ..	10	17½— 18
55,000	10	6/-	Do. 6% Cum. Pref.	10	14 — 14½
634,732	1	4.69d.	Swan, Hunter & Wigham-Richardson, Lim. Ord.	1	⅞— 1
538,845	1	6d.	Do. 5% Cum. Pref.	1	⅞— 1
£240,000	Stk	4¼%	Do. 4¼% 1st Mort.Deb Stk.Red	100	96 — 99*
300,000	1	6d.	Thames Iron Works, Shipbuilding & Engineering Co.,Ltd.,5% Cum.Pf.	1	½— 9/16
£200,000	100	4%	Do. 4% Irredeem.1st Mort.Deb.	100	67 — 71
£160,000	1	7½d.	Thornycroft (John I.) & Co., Ltd. 6% Cum. Pref.	1	15/16— 1 1/16
10,000	10	5/-	Tylor (J.) & Sons, Ltd. 5% Cum.Pf.	10	9½— 10*
$508495200	$100	$½	United States Steel Corp. Com.Stk.	$100	30⅛— 30⅝
$360314100	$100	$1¾	Do. 7% Cum. Pref. Stock	$100	94⅜— 94⅞
$162268 00	$1000	5%	Do. 10-60yr. 5% Skg.Fd.G.Bds.	$1000	94 — 96
3,350,000	1	1/-	Vickers, Sons & Maxim, Ltd. Ord..	1	2 9/16— 2 11/16
750,000	1	6d.	Do. 5% Non-Cum. Pref. ..	1	1⅛— 1¼
£750,000	Stk	5%	Do. 5% Non-Cum. Pref. Stock.	100	111 —114
£1,250,000	Stk	4%	Do. 4% 1st.Mort.Deb.Stk.Red.	100	103 —105
£1,000,000	100	4½%	Do. 4½% 2nd Mort. Debs.,Red.	100	103 —105
225,000	1	1/2⅝	Weardale Steel, Coal & Coke, Ltd., Def. Ord.	1	13/16— 15/16
500,000	1	7½d.	Do. 6% Cum. Pref. Ord. ..	1	⅞— 1
£300,000	Stk	4%	Do. 4% Perpetual Deb.Stock	100	85 — 89
7,637	5	2/9	Weldless Steel Tube, Ltd., Cum. Pref. 5½	5	4¾— 4⅞
300	Stk	4½%	Do. Mort. Deb. 4½%	100	93 — 98*
66,666	5	3/.	Willans & Robinson, Ord.	5	1 — 2
66,666	5	3/-	Do. 6% Cum. Pref.	5	2 — 3
£246,641	Stk	4%	Do. 4% 1st Mort.Deb.Stk.Red	100	74 — 79
£150,000	Stk	4½%	Yorkshire Iron & Coal Co., Ltd., 4½% 1st Mort. Deb. Stk. Red.	100	80 — 85*

Stocks and Shares marked * are quoted ex-dividend.

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ELECTRIC LIGHTING AND POWER.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£135,000	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	102 —104
111,000	3	—	London Elec. Supply Corp., Ld., Ord.	3	2⅛ – 2⅜
60,000	5	3/-	Do. 6% Pref.	5	5⅜— 5⅞
£371,895	Stk	4%	Do. 4% 1st Mort.Db.Stk.,Red	100	95 — 97
100,000	10	9/-	Metropolitan Elec. Sup. Co., Ld., Or.	10	18 — 18½
76,121	5	2/3	Do. 4½% Cum. Pref.	5	5 7/16—5 9/16*
220,000	Stk	4½%	Do. 4½% 1st Mort.Db.Sk.,Red	100	110 —115*
250,000	Stk	3½%	Do. 3½% Mort. Deb. Stk., Red.	100	96 — 98*
£250 000	—	4½%	Midland Elec. Corp. for Power Distribution Ld., 4½% 1st Mort.Deb.	100	92 — 95*
10,852	10	6/-	Notting Hill Elec. Ltg. Co. Ltd. Ord.	10	14½— 15
£59,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	101 —103
16,500	5	2/6	Oxford Electric Co. Ltd., Ord. ..	5	6⅛ — 6⅜
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	99 —101
£84,700	100	4½%	Royal Elec. Co. (of Montreal) 4½% 20-yr. 1st Mort. Deb	100	100 —102
40,000	5	5/-	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	13½— 14
20,000	5	3/6	Do. 7% Pref.	5	8½— 9
£150,000	Stk	3½%	Do. 3½% Deben. Stock, Red	100	98 —100*
12,000	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2¾— 3¼
£50,000	Stk	4%	Do. 4% Debenture Stk Red.	100	83 — 87
65,000	5	3/-	South London Elec. Sup. Co., Ltd. O.	5	4⅛— 4⅜
100,000	1	—	South Metropolitan Elec Light & Power Co., Ltd. Ord.	1	13/16 - 15/16
50,000	1	8⅔d.	Do. 7% Cum. Pref.	1	1⅜— 1 7/16
£100,000	Stk	4½%	Do. 4½% 1st Deb. Stock Red.	100	107 —110
50,000	5	2/6	Urban Electric Supply Co., Ltd., O.	5	5 — 5⅛
30,000	5	2/6	Do. 5% Cum Pref.	5	5 1/16 — 5 3/16
£200,000	Stk	—	Do. 4½% 1st Mort.Deb.Stk.Red	100	104 —106
110,000	5	6/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	12¾ — 13¼
28,151	5	2/6	Do. 5% Cum. Pref.	5	6¼— 6¾*

V.—TELEGRAPH & TELEPHONE COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£34,800	100	4%	African Direct Tel. Co., Ld., 4% Mt. Debs. (Series A), Red.	100	99 —102*
25,000	10	—	Amazon Telegraph Co., Ld... ..	10	½— 1
£763,580	Stk	12/6	Anglo-American Tel. Co., Ltd., Ord.	100	57 — 59
£3,118,210	Stk	25/-	Do. 6% Preferred Ordinary	100	103½—104½
£3,118,210	Stk	2/-	Do. Deferred Ordinary .	100	13¼— 13½
44,000	5	4/-	Chili Telephone Co., Ltd.	5	5⅞— 6⅛
$15,000,000	$100	$2	Commercial Cable Co., Capital Stk.	$100	170 —190
£1,903,856	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	92 — 94*
16,000	10	5/-	Cuba Submarine Tel. Co., Ld., Ord.	10	8¾— 9¼
6,000	10	10/-	Do. 10% Preference	10	16½— 17½
6,000	5	2/-	Direct Spanish Telegraph Co., Ord.	5	3⅜— 3⅝
		5/-	10% Cum. Preference	5	7¾— 8¼
£30,000	50	4½%	Do. 4½% Debs...	50	100-102%*
60,710	20	3/-	Direct U.S. Cable Co., Ltd... ..	20	10¾— 11
£85,800	100	4½%	Direct West India Cable Co., Ltd., 4½% Reg. Debs.	100	99 —101*
£300,000	100	4%	East. & S. African, Ld., 4% Mt. Db.	100	101 —103
£200,000	25	4%	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)..	25	100-102%
300,000	10	2/6	Eastern Extension, Australasia and China, Ltd...	10	13½— 14
£602,400	Stk	4%	Do. 4% Mort. Deb. Stk., Perp.	100	106 —108
£4,000,000	Stk	25/-	Eastern Tele. Co., Ltd., Ord. ..	100	135 —138
£2,000,000	Stk	17/6	Do. 3 % Pref.	100	88 — 90
£1,836,814	Stk	4%	Do. 4% Mort. Deb.	100	105 —107
150,000	10	5/-	Great Northern Telegraph Co., Ltd., (of Copenhagen) ..	10	28½— 29
£58,700	100	4½%	Halifax and Bermudas Cable Co., Ltd., 4½% 1st. Mort. Debs. Red.	100	99 —101*
17,000	25	12/6	Indo-European Tele. Co., Ltd. ..	25	44½— 45½
72,680	1	7⅕d.	Monte Video Telephone Co., Ltd., O.	1	13/16— 15/16
£1,983,333	Stk	6%	National Telephone Co., Ltd., Pref.	100	108½—109½
£1,966,667	Stk	5%	Do. Deferred	100	107—109
15,000	10	6/-	Do. 6% Cum. 1st Pref. ..	10	13 — 15
15,000	10	6/-	Do. do. 2nd do. ..	10	12 — 13
250,000	5	2/6	Do. 5% Non-Cum. 3rd Pref.	5	5 5/16— 5 7/16
£2,000,000	Stk	3½%	Do. 3½% Deb. Stk., Red. ..	100	93 — 95*
£689,593	Stk	4%	Do. 4% do. do. ..	100	101½-103½*
£1,0 0	—	5/9	Do. 4% Prov. Certs. all paid..	—	101½-103½*
179,313	1	7⅕d.	Oriental Telephone & Elec. Co., Ltd.	1	1 — 1⅛
50,000	1	7⅕d.	Do. 6% Cum. Pref.	1	1⅛— 1¼
£100,000	100	4%	Pacific & European Tel. 4% Guar. Debs. Red...	100	96 — 99*
11,839	8	4/-	Reuter's Telegram Co., Ltd. ..	8	7 — 7½
58,000	5	3/-	United River Plate Telep. Co., Ltd.	5	6½— 6¾*
40,000	5	2/6	Do. 5% Cum. Pref.	5	5 — 5¼*
£179,947	Stk	5%	Do. 5% Deb. Stock, Red. ..	100	104—106*
15,609	10	4/-	W. African Telegraph Co., Ltd. ..	10	7¼— 7¾

TELEGRAPHS AND TELEPHONES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£30,008	2½	—	West Coast of America, Ltd. ..	2½	½— ⅝
150,000	100	4%	Do. 4% Deb. Guar. by West. Tel.	100	97 — 99*
88,341	10	6d.	W.India&PanamaTeleg.Co.,Ld.,Or.	10	⅝— ¾
34,563	10	6/-	Do. 6% Cum. 1st. Pref. ..	10	7⅜— 7⅝
4,669	10	6/-	Do. 6% Cum. 2nd Pref. ..	10	6¾— 7¼
£80,000	100	5%	Do. 5% Deb.	100	101 —103*
207,930	10	3/-	Western Telegraph Co., Ltd. ..	10	13½— 14
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	101 —103*
518,915	Stk	4%	Do. 4% Deb. Stock, Red. ..	100	101 —102*

VI.—SHIPPING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
32,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 5½% Cum. Pref.	10	8½— 9
£315,000	Stk	4½%	Do. 4½% Red. 1st Mort. Deb.Stk.	100	98 —100
£674,900	Stk	4½%	British & African Stm. Nav. (1900), Ltd., 4½% 1st Mort. Deb. Stk. Red.	100	91 — 93*
40,000	10	5/6	Bucknall Steamship Lines, Ltd., 5½% Cum. Pref.	10	6 — 7
£600,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk.	100	73 — 76*
£750,000	Stk	4½%	Clan Line Steamers, Ltd., 4½% Deb. Stk. Red. ..	100	98 —100*
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000..	20	13 — 13½
40,000	20	8/-	Do. Nos. 60 001-100,000	10	5¾— 6¼
£461,430	Stk	4½%	Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. ..	100	100 —102
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord...	1	1 — 1⅛
30,000	10	5/-	Do. 5% Cum Pref.	10	9¾— 10¼
327,300	100	4½%	Do. 4½% 1st Mort.Debs.Red.	100	105 —107
25,323	7½	4/7	Gen.Steam Navigation Co., Ld., Ord.	7½	4¼— 4¾
36,758	8	4/9⅗	Do. Non-Cum. 6% Pref.	8	7¼— 7¾
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	95 — 97*
55,000	5	1/3	Houlder Line, Ltd., Ord.	5	3 — 3½
40,000	5	2/9	Do. 5½% Cum. Pref.	5	3¼— 3¾
£200,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk. Red.	100	83 — 86*
141,500	10	5/-	Leyland (Fredk.), & Co. (1900), Ltd., 5% Cum Pref. ..	10	5¼— 5¾
£1,160,000	Stk	5 %	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. ..	100	126 —129
£1,160,000	Stk	19%	Do. do. Deferred ..	100	216 —219
£800,000	Stk	3½%	Do. do. 3½% Deb. Stock .	100	99 —101
£648,100	Stk	3½%	Do. do. 3½% 2nd Deb. Stk.	100	96 — 98
15,000	100	30/-	Royal Mail Steam Packet Co. Ord.	60	25 — 26
39,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref..	5	4¾— 5¼
39,075	5	2/6	Do. "B" Ord...	5	4 — 4½
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord..	10	8 — 8½
24,000	10	4/6	Do. 4½% Cum. Pref... ..	10	9½— 10*
£1,038,894	Stk	4%	Do. 4% Debenture Stk., Red.	100	99 —101*

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
60 000	1	9⅗d.	Chadburn's (Ship Tele. Ltd., Ord...	1	⅞— 1⅛
£750,000	Stk	5%	General Hydraulic Power Co., Ltd.	100	136 —141
12,500	10	10/-	Oakey (John) and Sons, Ltd., Ord..	10	24 — 26
10,000	10	6/-	Do. do. 6% Cum. Pf.	10	14 — 15
183,538	1	6·3d.	Power Gas Corp., Ltd., Ord., Nos. 66,463-250	15/-	5/16— 7/16
63,462	1	8·4d.	Do. do. Nos. 1 66,462	1	9/16— 11/16
135,000	1	6d.	Waygood (R.) & Co., Ltd., Ord. ..	1	1⅛— 1¼
135,000	1	7½d.	Do. 6% Cum. Pref. ...	1	1⅛— 1¼

RAILWAY CARRIAGE & WAGON COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend	Name.	Paid up.	Closing Prices
10,000	10	7/6	Birm. Railway-Car. & Wagon, L., 1-10,000	10	21 — 21½
8,739	10	3/-	Do. Second Issue 1-8,739 ..	4	8¼— 8¾
10,000	10	6/-	Do. Cum. Pref. 6% 1-10,000..	10	13 — 13½
30,111	7	7/-	Gloucester Rail.-Car & Wagon, Ld., A, 1-29,861 & 49,751-50 000	7	8¾— 9
44,889	7	3/6	Do. B, 29,862-49,750, 50,001-75,000	7	4½— 4⅝
784,808	1	9d.	Metropolitan Amalgamated Rail.-Carriage & Wagon, Ld., 1-784,808	1	39/6— 40/6
164,288	1	6d.	Do. Cum. A Pref. 5% 1-164,288	1	24/- —25/-
235,000	1	7½d.	Do. Cum. B Pref. 6% 1-235,000	1	28/- —28/6
20,000	20	20/-	Midland Rail.-Car. & Wagon, Ltd., 1-20,000	10	19 — 19½
10,000	20	7½d.	Do. Pref. 6 per cent. 1-10,000		22/3— 22/9

Stocks and Shares marked * are quoted ex-dividend.

II.—ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
70,000	1	6d.	Alliance Elec. Co., Ltd. 5% Cum. Pf.	1	5/8— 7/8
125,000	1	7½d.	Aron Elec. Meter Ltd., 6% Cum. Pf.	1	7/16— 9/16
120,000	1	9⅜d.	Bell's Asbestos Co., Ltd.	1	13/16— 15/16
100,000	5	4/-	British Insulated & Helsby Cables Ltd., Ord. ..	5	5 — 5½
100,000	5	3/-	Do. 6% Cum. Pref.	5	5¼— 5¾
£500,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Rd.	100	101 —104*
£200,000	Stk	4½%	British Thomson-Houston Co., Ltd., 4½% 1st Mort. Deb. Stk. Red. ..	100	101 —103
400,000	5	8/-	British Westinghouse Electric and Manufac. Co., Ltd., 8% Pref. ..	5	2⅝— 2⅞
£616,858	Stk	4%	Do. 4% Mort. Deb Stk. Red...	100	86 — 88*
105,781	2	2/-	Brush Elec. Enging. Co., Ltd., Ord..	2	⅝— ⅞
150,000	2	2/4⅘	Do. 6% Pref.	2	1¼— 1½
£125,000	Stk	4½%	Do. 4½% Perp. 1st Deb. Stk...	100	93 — 96
£125,000	Stk	4½%	Do. 4½% Perp. 2nd Deb. Stk.	100	73 — 76*
35,000	5	5/-	Callender's Cable & Constn. Ltd. Ord.	5	9 — 10
40,000	5	2/6	Do. 5 % Cum. Pref.	5	5 — 5¼
£200,000	Stk	4½%	Do. 4½% 1st Mort. Deb Stk. Red.	100	104 —106*
85,000	3	1/6	Crompton & Co., Ltd...	3	2 — 2¼
£100,000	—	5%	Do. 5% 1st Mort. Reg. Debs.	100	93 — 98*
52,000	5	10/-	Dick, Kerr & Co., Ltd., Ord. ..	5	8 — 8½
61,000	5	3/-	Do. 6% Cum. Pref.	5	5¾— 6
£800,000	Stk	4½%	Do. 4½% Deb. Stock, Red. ..	100	105 —107*
233,334	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	1⅛— 1⅜
£233,334	Stk	4%	Do. 1st Mort. 4% Free. Deb. Stk.	100	105 —108
99,261	5	1/6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	3	⅝— ⅞
17,139	5	2/6	Do. "A" Shares Nos. 01-017,139	5	1 — 1½
£344,028	Stk	4%	Do. 4% Deb. Stock Red. ..	100	78 — 83*
£100,000	Stk	5%	Do. 5% Second Deb. Stk. Red.	100	79 — 84
112,100	2	1/7⅕	Electric Construction Co., Ltd. .	2	1⅛— 1¼
31,890	2	2/9⅗	Do. 7% Cumulative Pref. ..	2	2¼ - 2½
£200,000	Stk	4%	Do. 4% Perp. 1st Mt. Deb. Stk.	100	98 —100
10,248	10	7/6	Evered and Co., Ltd...	10	13 — 15
£100,000	Stk	5%	Ferranti, Ltd., 5% 1st Mort. Deb. Stock, Red...	100	90 — 95
25,000	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9½— 10*
£200,000	Stk	4%	Do. 4% 1st. Mt. Deb. Stk., Red.	100	91 — 96
85,000	5	5/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	10¼— 10¾
85,000	5	2/3	Do. 4½% Cum. Pref... ...	5	5⅛— 5⅜
£50,000	Stk	4½%	Do. 4½% Mt. Deb. Stk. Red.	100	110 —112
50,000	10	5/-	India Rubber, Gutta Percha & Telegraph Works Co., Ltd.,	10	15 — 16*
£300,000	100	4%	Do. 1st Mort. Deb. Red. ..	100	99 —102
7,500	10	—	Parker, Thos., Ltd.	10	6½— 7
37,350	12	12/-	Telegraph Construction and Maintenance Co., Ltd.	12	38 — 40
£150,000	100	4%	Do. 4% Deb. Bonds	100	101½-103½*

III.—ELECTRIC TRACTION.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
120,000	5	3/-	Anglo-Argentine Trams Co., Ld., Or.	5	8⅛— 8¼
260,007	5	2/6	Do. 5% Cum Pf.	5	5 7/16 —5 9/16
£230,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888	100	140 —143*
20,000	10	6/-	Barcelona Trams Co., Ltd., Ord. ..	10	12 — 12½
10,000	10	5/-	Do. 5% Cum Pf. Share	10	9 — 10*
£46,800	100	5%	Do. 5% Debs., Red.	100	98 —101
£191,326	Stk	4½%	Do. 4½% Red. Deb. Stk.	100	95 —100
75,6[illegible]6	1	—	Bath Elec. Trams. Ld., Pf. Or. ..	1	⅝ - ¾
59,894	1	11·49d	Do. 5% Cum. Pf. ..	1	⅞— 1*
75,000	5	—	Brisbane Electric Tram Investment Co., Ltd., Ord... .	5	1½— 2
75,000	5	2/6	Do. 5% Cum. Pf. .	5	3¾— 4¼
£425,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	94 —98*
£200,000	Stk	6%	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	100 —103
		5%	Pref. Ord. Stock	100	100 —103
7,500	10	5/-	Do. 5% Cum. Perp. Pf. ..	10	10¼— 10¾
£242,800	40	4½%	Do. 4½% 1st Mort. Debs.	40	102 104%
£220,000	100	4½%	Do. 4½% Vancouver Power Db.	100	98 —101
188,101	10	6/-	Brit. Electric Traction, Ltd., Ord.	10	9¾—10¼*
156,437	10	6/-	Do. 6% Cum. Pref... .	10	11 — 11½
£1,000,000	Stk	5%	Do. 5% Perp. Deb. Stk. ..	100	118 —120
£250,000	Stk	4½%	Do. 4% 2nd Deb. Stk. Red.	100	96 — 98
100,000	5	1/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	3⅞— 4
40,500	5	3/-	Do. "A" 6% Cum Pref. .	5	5⅜— 5⅝
27,000	5	3/-	Do. "B" do.	5	5⅛— 5⅜
£200,000	Stk	5%	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	94 — 97*
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	98 —101
102,268	5	3/-	Calcutta Tramways Co., Ltd.	5	8¼— 8
£350,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	106 —108*
480,000	1	1/-	Cape Electric Tramways, Ltd. ..	1	1¼— 1¾
40,000	5	2/6	City of Birmingham Trams Co., Ltd. 5 % Cum. Pref.	5	4⅞— 5
£300,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	98 —102
155,000	5	4/-	City of Buenos Ayres Trams. Co., Ld.	5	10¼— 10
£116,000	Stk	6%	Do. Per. 6% Deb. Stk...	100	140 —145
£120,000	Stk	5%	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	101 —104
60,000	10	6/-	Dublin United Trams. Co. (1896), Ltd., Ord. ..	10	13 — 14
59,987	10	6/-	Do. 6% Pref...	10	15 — 16
30,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	3½— 4
£150,000	Stk	4%	Do. 4% Deb. Stock . ..	100	88 — 91*
125,000	10	5/-	London United Trams. (1901), Ltd., 5% Cum. Pref.	10	10⅜—10⅝
£1,031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	101 —103*
£50,000	Stk	5%	Madras Electric Trams (1904), Ltd., 5% Deb Stock, Red.	100	103 —105*
314,016	1	—	Metropolitan Elec. Trams, Ltd., Def.	1	⅜— ½
500,000	1	6d.	Do. 5% Cum. Pref... .	1	⅞— 1
£350,000	Stk	4½%	Do. 4½% Deb. Stock, Red.	100	102 —104*
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	⅞— 1⅛
110,923	8	2/9⅗	North Metropolitan Tramways Co..	8	4¼— 4¾
£150,000	100	3½%	Do. 3½% Mort. Debs.	100	90 — 95*
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red..	100	101 —104*
24,500	10	10/-	Potteries Elec. Traction Co., Ld., Or.	10	8 — 9
24,500	10	5/-	Do. 5% Cum. Pref. ..	10	8½— 9½
£220,000	Stk	4½%	Do. 4½% Deb. Stk., Red.	100	99 —102

IV.—ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
7,500	10	16/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. ..	10	12 — 13½
7,500	10	4/6	Do. 4½% Cum. Pref. ..	10	9½— 10
7,500	10	6/-	Do. 6% Cum. Second Pf. ..	10	11 — 12
£70,000	Stk	4½%	Do. 4½% Deb. Stock Red ..	100	102 —104*
14,000	5	2/-	Bromley (Kent) Elec. Lt. & Pr. Co. Ld	5	5½— 5¾
£50,000	Stk	4½%	Do. do. 4½% 1st Deb. Stk. Red.	100	101 —104
27,507	5	4/6	Brompton & Kensington Elec. Supply Co., Ltd. Ord. ..	5	10½— 11
12,493	5	3/6	Do. 7% Cum. Pref. Shares..	5	10½ - 10¾
60,000	5	3/-	Calcutta Elec. Sup. Cor. Ltd., Ord	5	8½— 8¾
£288,782	Stk	4%	Central Elec. Sup. Co., Ltd., 4% Gua. Deb. Stk. .	100	105 — 108
70,000	5	4/-	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord... ..	5	8¼— 8¾
10,000	5	—	Do. do. Ord. ..	5	8 — 8½
80,000	5	2/3	Do. do. 4½% Cum. Pref...	5	5 9/16— 5 11/16
£350,000	Stk	4%	Do. do. 4% Deb. Stk. Red.	100	101 —103
40,000	5	2/3	Do. do. "City Undertaking" 4½% Cum. Pref ..	5	4⅞ —5 1/16*
40,000	5	2/3	Do. do. do. (1903) ..	5	4⅞—5 1/16*
41,436	5	2/3	Chelsea Elec. Sply. Co., Ltd., Ord..	5	6⅞— 7
£150,000	Stk	4½%	Do. do. 4½% Deb Stk., Re[illegible]	100	107 —109*
70,595	10	6/-	City of London El. Lghtg. Co., Ld., O	10	11 — [illegible]
40,000	10	6/-	Do. 6% Cum. Pref. .	10	13½— 14
£400,000	Stk	5%	Do. 5% Deb. Stk., Red ..	100	121 —1[illegible]
£300,000	Stk	4½%	Do. 4½% 2nd Deb. Stk., Re	100	101 —1[illegible]
40,000	10	4/-	County of London Elec. Supply Co., Ltd., Ord.	10	9 —
30,000	10	6/-	Do. 6% Cum. Pref. ..	10	12 — 1[illegible]
£400,000	Stk	4½%	Do. 4½% Deb. Stk., Red. .	100	107 —1[illegible]
£250,000	—	4½%	Do. 4½% 2nd Deb. Stk., Prv. Crts. all paid, Rd	100	101 —1[illegible]
70,000	5	4/6	Edmundson's Elec. Cor. Ltd., Or .	5	6⅜—
70,000	5	3/-	Do. 6% Cum. Pre. ..	5	6 —
£300,000	Stk	4½%	Do. 4½% 1st Mort. Db. Stk. Reg	100	107 —1[illegible]
£80,000	Stk	5%	Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. Stk. Red.	100	86 — [illegible]
10,000	5	2/-	Folkestone Elec. Supply Co., Ld., O	5	5½—
£50,000	Stk.	4½%	Do. 4½% 1st Deb. Stk., Red.	100	102 —1[illegible]
15,000	10	—	Havana Electricity Co., Ltd. . ..	10	9½—1[illegible]
13,000	5	8/6	Hove Elec. Lighting Co., Ltd., Ord	5	7½— [illegible]
£50,000	Stk	4½%	Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock. Red.	100	10[illegible]—1[illegible]
150,000	1	—	Kalgoorlie Electric Power & Lighting Corp. Ltd., 6% Cum. Pref.	1	3/16— [illegible]
21,000	5	5/-	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord. ..	5	12½— 1[illegible]

Stocks and Shares marked * are quoted ex-dividend.

PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

MARKET REPORT.

Wednesday, January 11th, 1905.

COPPER opened the year with a strong market and remains active and buoyant. The home trade is good, the Continent has been a heavy buyer and consumption in the United States is steadily increasing. As a result it has been a little difficult to buy except for forward delivery, and those who desired to fill early requirements, have had to concede the higher prices asked. The strong appearance of the metal has been reflected in the speculative market, and the quotation has been firm at about £69. The position appears to justify higher values, although yesterday the price receded.

Tin, after a short spell of depression, has exhibited symptoms of recovery, the scarcity of spot metal on the market having induced speculative operations for the rise. Messrs. Merton and Co.'s statistics for the past month show a decrease of 721 tons, excluding America. The closing price yesterday was, however, lower at £131 10s. cash, £130 15s. three months.

In the Iron and Steel Market there is little or nothing fresh to record. Pig iron has been firm without much business passing, and finished iron and steel has been active. The reports from industrial centres are fairly encouraging, and the trade outlook is tolerably bright. The new contract for standard iron is now in force and many dealings have taken place under it. The statistics of Scotch pig iron for 1904 show that production increased 51,667 tons and consumption increased 97,864 tons. Exports were lower and stocks show an increase of 27,356 tons. Messrs. Merton and Co.'s circular gives the stock of Middlesbrough iron at 192,021 tons.

In the Lead Market there has been a good speculative demand, and with holders rather unwilling to sell at ruling quotations an improvement in values has to be recorded.

Spelter is rather harder, owing to the large demand for galvanised iron, consumers still buying against sales of the manufactured article. Producers are all well sold for months to come.

In the Coal section large steam has been unusually active during the past week, and prices have stiffened appreciably all round. The small coal department is good for prompt delivery, and house coal is rather firmer.

In the Shellac Market things are inclined to quiet down.

IRON, STEEL, PIG-IRON, &c.

SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as follows. Prices delivered in Glasgow or equal :—

Steel:	£	s.	d.
Siemens' Steel Plates, Marine Boiler Quality	6	15	0
,, ,, ,, Land ,, ,, ...	6	17	6
,, ,, ,, Ship Quality Plates............	5	15	0
Siemens' Steel Bars, Boiler Quality	6	15	0
,, ,, ,, Ship ,, ...	6	5	0
,, ,, Angles.....................................	5	5	0
Manufactured Iron:			
Bars—Dalzell..	6	2	6
,, **Best**	6	12	6
,, ,, **Horseshoe**	6	12	6
,, **Angle**...	6	2	6
,, **Best Angle**	6	12	6
,, **Best Best**	7	2	6
,, **Extra Best**	7	12	6

Usual terms and extras. Special rates for delivery in England and export. The above prices subject to alteration without notice.

The Glasgow Iron and Steel Co., Ltd., Wishaw, quote as under (prices are delivered Glasgow or equal) :—

	£	s.	d.	
Steel Angles (Glasgow ♛ Steel)...............	5	5	0	per ton.
Steel Ship Plates (Glasgow ♛ Steel)	5	15	0	,,
Steel Bars, Ship Quality (Glasgow ♛ Steel)	6	5	0	,,
Steel Bars, Boiler Quality (Glasgow ♛ ♛ Steel)	6	15	0	,,
Steel Land Boiler Plates (Glasgow ♛ ♛ Steel)	6	5	0	,,
Steel Marine Boiler Plates (Glasgow ♛ ♛ Steel)	6	5	0	,,

Less 5 per cent. discount. Extras as per standard list.

Special prices for delivery in England and for export. The above prices subject to alteration without notice.

John Spencer (Coatbridge), Ltd., Phœnix Ironworks, Coatbridge, N.B., quotes :—

	£	s.	d.
Bars—Phœnix	6	5	0
,, **Best**...	6	15	0
,, **Best Best**	7	5	0
,, **Extra Best**...	7	15	0
,, **Best Horse Shoe**	6	15	0
,, **Extra B.H.S.**	7	15	0
,, **Extra Best Cable**	8	5	0
,, **Rivet**	6	5	0
,, **Best Scrap Rivet**	7	5	0

	£	s.	d.
Angles Phœnix	6	5	0
,, Best	6	15	0
,, Extra Best	7	5	0
Gas Tube Hoops Phœnix Best	6	15	0
Plates—Phœnix			
,, Best Boiler	7	10	0
,, Best Best Boiler	8	0	0
,, Extra Best Boiler	9	0	0
Boiler Tube Strips—Phœnix Best Best	8	0	0

All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly.

Messrs. R. Feldtmann and Co., of Glasgow, quote Commission extra).

Pig Iron:

	No. 1.			No. 3.		
	£	s.	d.	£	s.	d.
Coltness, f.a.s. Glasgow	3	5	0	2	15	0
Gartsherrie ,,	2	19	6	2	14	6
Summerlee ,,	2	19	0	2	14	0
Carnbroe ,,	2	15	0	2	13	0
Langloan ,,	3	4	0	2	15	0
Calder ,,	2	19	0	2	14	6
Clyde ,,	2	19	0	2	14	6
Glengarnock, f.o.b. Ardrossan	2	19	0	2	13	6
Eglinton ,, ,,	2	15	0	2	13	0
Dalmellington, ,, Ayr	2	15	0	2	13	0
Shotts ,, Leith	2	19	0	2	14	6

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, **at works**:—

	£	s.	d.
W.W. ♛ Bars	6	7	6
W.W. Best Bars	6	17	6
W.W. Best Best	7	7	6
W.W. Best Best Best	7	17	6
W.W. Best Shoe	6	17	6
Thornaby ♛	7	17	6
Thornaby Best	8	7	6
Thornaby Best Best	9	7	6
Whitwell Special Admiralty Cable	10	0	0
Special Chain Iron	9	0	0
Tube and Nail Strips	6	10	0
W.W. ♛ Angle Iron	6	10	0
W.W. Best Angle Iron	7	0	0
Tee Iron, to 8 inches United	7	7	6

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington, quote:—

	Iron.			Steel.		
	£	s	d.	£	s.	d.
Crown (BNF) Bars	6	10	0	7	0	0
,, ,, Angles	7	0	0	7	10	0
,, ,, Tees	7	10	0	8	0	0
,, (WIW) Hoops	7	0	0	7	10	0
,, ,, Sheets	7	10	0	8	0	0

Ordinary Sizes, F.A.S. Liverpool in 10-ton Lots.
Extras for Sizes and Cutting as per List.

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

Black Sheets:	Singles 20 G 96in. by 36in. per ton.			Doubles 21 G to 24 G 96in. by 36in. per ton.		
	£	s.	d.	£	s.	d.
"Vale"	10	0	0	10	10	0
"Shield"	10	10	0	11	10	0
"Severn"	11	10	0	12	10	0
"Baldwin Wilden B."	12	10	0	13	10	0
Charcoal	16	10	0	17	10	0
Best Charcoal	18	10	0	19	10	0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:

	£	s.	d.	£	s.	d.
No. 3 Lead	13	10	0	14	10	0
S.V. Lead	15	0	0	16	0	0
No. 3 Terne	15	0	0	16	0	0
S.V. Terne	16	10	0	17	10	0

Tinned Sheets:	Singles 20 G to 108 by 36in. per ton.			Doubles 21 to 24 G to 96 by 36in per ton.		
	£	s.	d.	£	s.	d.
Best Coke (Finish)	28	0	0	29	10	0
,, Charcoal (Finish)	30	0	0	31	10	0
Extra ,, ,,	32	0	0	33	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.

Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box

Extreme sizes in Tin and Patent Coated specially quoted for.

Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.

At works less 2½% for cash monthly, 10th inst.

Galvanized Corrugated Sheets:

	£	s.	d.	
"Phœnix" Brand, 24 G., f.o.b. London, in Bundles	11	15	0	per ton.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	14	7	6	,,

Galvanized Working Up-Sheets:

	£	s.	d.	
24 G., f.o.b. London, in Bundles	13	15	0	per ton.

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£	s.	d.	
Crown Bars	6	10	0	per ton.
Best Bars (1 to 6in. wide, above ½ in. thick, ½ in. to 4 rounds and squares)	7	0	0	,,
Angles	6	15	0	,,
,, Best	7	5	0	,,
T's	7	0	0	,,
,, Best	7	10	0	,,
Best Shoe Iron	8	0	0	,,
,, Rivet Iron	8	0	0	,,
,, Best Rivet (Special)	9	5	0	,,
,, Cable	9	5	0	,,
,, Screwing	8	5	0	,,

	£	s.	d.	
Best Turning	8	0	0	per ton.
,, Plating	8	5	0	,,
,, ,, Best Best	9	5	0	,,
,, ,, Treble	10	5	0	,,
Plates	7	10	0	,,
Best Plates	8	0	0	,,
,, Boiler Plates	8	10	0	,,
,, Best Boiler Plates	9	10	0	,,
Treble Best Boiler Plates	12	0	0	,,

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon., quote "Star" brand patent wrought nails, steel nails, &c.

Discounts—

45 per cent. off 1-inch to 3-inch strong rose and all fine rose and 6dy. and 8dy. pound.

40 per cent. off 3½ inch to 7-inch strong rose and 10dy. and 20dy. pound.

40 per cent. off all sharp-pointed nails.

Delivered in lots of 4 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis:—

2 tons 9/3 per cwt.
4 cwt. lots and upwards 9/6 per cwt. } d/d any Railway Station.

Steel cut nails, 3-inch basis—

2 tons 8/- per cwt.
4 cwt. lots 8/3 per cwt. } d/d any Railway Station.

Slit rods (iron) £7 10s. per ton, at works for 2-ton lots.

Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E. C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla, quote:—

	Per Box. f.o.b. Wales. £	s.	d.
Coke Tin-plates.			
C 18¾ by 14 124s. 110 lb. "BV"	0	18	0
C 20 by 10 225s. 155 ,, "Jumbo"	0	18	3
C 20 by 14 112s. 108 ,, "Lydbrook"	0	12	6
C 28 by 20 112s. 216 ,, "Lydbrook"	1	5	3
Charcoal Tinplates:			
C 20 by 14 112s. 108 lb. "Allaway"	0	13	3

BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes:—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

		£	s.	d	
Steel:					
Blooms	at	3	12	0	per ton.
Billets	at	3	14	0	,,
Sheet Bars	at	3	16	0	,,
Finished Steel:					
Bars	at	4	17	6	per ton.
Angles	at	4	18	6	,,
Tees	at	5	0	0	,,
Joists	at	4	10	0	,,
Fencing Standards	at	5	1	0	,,
Shoeing Bars	at	5	2	0	,,
Tyre Bars	at	5	4	0	,,
Half-Round Bars	at	5	5	0	,,
Heavy Rails	at	4	10	0	,,
Light Rails	at	4	17	6	,,

Structural Steelwork:

Prices on application.

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote:—

TIN.

Tin:	£	s.	d.		£	s.	d.	
English Ingots, f.o.b. Dis. 1¼% & 1%	132	0	0	to	132	10	0	per ton.
English Bars, f.o.b. Dis. 1¼% & 1%	133	0	0	to	133	10	0	,,
Straits G.M.B., cash Warehouse, Net	131	10	0	to	131	15	0	,,
Straits G.M.B., 3 months, Warehouse, Net	130	15	0	to	131	0	0	,,
Australian, Mr. Bischoff, Warehouse, Net	132	0	0	to	132	5	0	,,

COPPER.

Copper:	£	s.	d.		£	s.	d.	
Standard G.M.B., cash Warehouse, Net	68	7	6	to	68	10	0	per ton.
Standard G.M.B., 3 months, Warehouse, Net	68	15	0	to	68	17	6	,,
English, Tough, Cake & Ingot, Warehouses, Net	71	5	0	to	71	15	0	,,
English, Best Select, Warehouse Net	72	10	0	to	73	0	0	,,
English, Sheets and Sheathing, f.o.b., Dis. 2½%	79	0	0	to	79	10	0	,,
English, Sheets for India, f.o.b., Dis. 2½%	76	0	0	to	76	10	0	,,
Electro, Warehouse, Net	70	0	0	to	70	10	0	,,
Ore, ex. ship	0	12	0	to	0	13	0	per unit.
Regulus, Matte and Precipitate, ex. ship,	0	13	3	to	0	14	0	,,

YELLOW METAL.

Yellow Metal:	£	s.	d.	£	s.	d.	
Sheets, 4 by 4 feet for India f.o.b. Dis. 2½%				0	0	6¾	per lb.
Sheathing ,, ,,				0	0	6⅞	,,

SPELTER.

	£	s.	d.		£	s.	d.	
Silesian outports, Net	25	2	6	to	25	5	0	per ton.
Blende of 50% Net	7	0	0	to	7	10	0	,,
Calamine, Net	7	2	6	to	7	12	6	,,

LEAD.

	£	s.	d.		£	s.	d.	
English Pig, Warehouse, Dis. 2½%	13	2	6	to	13	5	0	per ton.
Spanish, ex ship, Dis. 2½%	13	0	0	to	13	2	6	,,
Lead Ore of 70%, Net	6	12	6	to	6	15	0	,,

ANTIMONY.

	£	s.	d.		£	s.	d.	
Star Regulus, f.o.b., Dis. 2½%	37	0	0	to	38	0	0	per ton.
Ore, 50%, ex ship, Dis. 2½%	8	0	0	to	9	0	0	,,
Crude, ex ship, Dis. 2½%	13	10	0	to	14	0	0	,,

QUICKSILVER.

	£	s.	d.	
Spanish, 75 lb., Warehouse, Net	7	15	0	per flask.
Italian ,, ,, ,,	7	14	0	,,

	£	s.	d.	
Soda: Ash, Caustic, 48 %, Ordinary ... ,,	5	5	0	per ton.
,, ,, ,, Refined...... ,,	6	5	0	,,
,, Carbonated, 48 %............ ,,	5	10	0	,,
,, ,, 58 % (Ammonia Alkali) ....net	4	10	0	,,
,, Bleachers' Refined Caustic 50/52 % .... net	6	10	0	,,
Caustic, White, 77 %.............. ,,	10	10	0	,,
,, ,, 70 %.............. ,,	9	12	6	,,
,, ,, 60 %.............. ,,	8	12	6	,,
,, Cream, 60 %..... .... ,,	8	10	0	,,
Crystals, in bags	3	0	0	,,
,, barrels	3	7	6	,,
Acetate .... c.i.f. Hull net	16	10	0	,,
Bicarbonate, in 1 cwt. kegs...........	6	15	0	,,
Bichromate......delivered England...	0	0	2¼	per lb.
Chlorate .... net	0	0	3$\frac{1}{16}$	per lb.
Nitrate...ex quay Liverpool, ... ,,	11	0	0	per ton.
Phosphate	9	5	0	,,
Prussiate ....net	0	0	3⅝	per lb.
Silicate, Solution, 140° Tw.	4	10	0	per ton.
Sulphate (Glauber Salts)...............	1	12	6	,,
,, (Saltcake, 95%)...............	1	15	0	,,
Sulphur: Recovered	4	15	0	,,
Roll	6	15	0	,,
Flowers..................................	7	10	0	,,
Zinc: Sulphate	6	15	0	,,

MINERALS.

	£	s.	d.	
Barytes: Lump Carbonate, 90/92%	3	10	0	per ton.
Sulphate, No. 1, White	2	15	0	,,
China Clay: of various qualities for all purposes; prices from about 11/– to about 30/– per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid.				
Chrome Ore: Basis 50% c.i.f. British Ports..........	3	7	6	,,
Manganese: Lump c.i.f. Liverpool 10¼d.	per metallic unit.			
Ochre: French JC .... f.o.b. Rouen, net	2	5	0	per ton.
,, JF	5	10	0	,,
Talc: (French Chalk).........c.i.f. Liverpool	3	10	0	,,

OILS, etc.

	£	s.	d.	
Aniline Oil ....net	0	0	4¾	per lb.
,, **Salt**.......... .... ,,	0	0	4½	,,
Castor Oil: French, 1st pressure, f.o.b. Marseilles less 1¼%.........	20	0	0	per ton.
English, 1st pressure, f.o.r. Hull, less 2½%..............	21	15	0	,,
Cocoa Nut Oil: Ceylon, ex store Manchester..............net	31	10	0	,,
Cochin, ex store Manchester.. ....net	33	0	0	,,
Cotton Seed Oil: Refined at Hull, less 2½% naked	14	17	6	,,
Edible...at Hull, less 2½% naked	15	7	6	,,
Glycerine: Crude, 80% ....net	31	0	0	,,
Linseed Oil: Raw... ..at Hull, less 2½% naked	13	10	0	,,
Boiled......at Hull less 2½% naked	14	10	0	,,
Starch: American Pearl...at Manchester, net	9	0	0	,,
Dextrine............ ,, ,,	18	0	0	,,
Farina................ ,, ,,	15	15	0	,,
Shellac: Standard TN orange spot	165/-			per cwt.
March delivery	145/-			,,
Turpentine: American.........at Liverpool	38	10	0	per ton.
Russian ....at Hull...net	18	10	0	,,

TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote:—

COLONIAL WOODS.

Timber.

		£	s.	d.		£	s.	d.
Quebec Square White Pine...	per cub. ft.	0	1	9	to	0	3	0
Quebec Waney Board Pine...	,,	0	2	8		0	3	9
St. John Pine, 18 in. average	,,	0	2	3		0	3	3
Lower Ports Pine...............	,,	0	1	3		0	1	8
Quebec Red Pine	,,	0	1	6		0	2	0
Quebec Oak, 1st quality	,,	0	2	9		0	3	3
Quebec Oak, 2nd quality ...	,,	0	1	6		0	2	6
Ash	,,	0	1	6		0	2	3
Elm	,,	0	3	0		0	3	9
Hickory	,,	0	2	0		0	2	6
Quebec Birch	,,	0	1	6		0	2	3
St. John Birch	,,	0	1	6		0	2	0
Birch Planks.....................	,,	0	0	9		0	0	11
Spruce Spars	,,	0	0	10		0	1	0

Deals.

		£	s.	d.		£	s.	d.
1st quality Quebec Pine	per std.	22	10	0	to	32	10	0
2nd do. do.	,,	17	0	0		22	0	0
3rd do. do.	,,	11	10	0		13	0	0
St. John, N.B., etc., Spruce	,,	6	10	0		6	15	0
Lower Ports Spruce..	,,	6	0	0		6	10	0
Spruce Boards................	,,	5	10	0		6	0	0

UNITED STATES, etc., WOODS.

Pitch Pine.

		£	s.	d.		£	s.	d.
Hewn	per cub. ft.	0	1	3	to	0	1	8
Sawn	,,	0	0	10		0	1	6
Planks, Stowage	,,	0	0	10		0	1	0
Boards, Prime	per std.	12	10	0		16	0	0
Oak Timber	per cub. ft.	0	1	6		0	2	6
Oak Planks	,,	0	1	6		0	2	1
East India Teak..............	per load	12	0	0		15	0	0
Greenheart.....	,,	6	15	0		7	10	0

EUROPEAN WOODS.

Timber.

		£	s.	d.		£	s.	d.
Riga Redwood	per cub. ft.	0	1	9	to	0	2	3
Dantzic and Memel Fir, Crown	,,	0	2	1		0	2	6
Dantzic and Memel Fir, Middling	,,	0	1	9		0	1	11
Stettin	,,	0	1	9		0	1	11
Swedish	,,	0	1	2		0	1	4
Riga Whitewood	,,	0	1	3		0	1	6
Norway Mining Timber	,,	0	0	9		0	0	10
Dantzic and Stettin, etc., Oak..	,,	0	2	6		0	3	0
Norway Spars.................	,,	0	1	2		0	1	9

Deals.

		£	s.	d.		£	s.	d.
Red Archangel and Onega, 1st quality	per std.	19	0	0		21	0	0
Red Archangel and Onega, 2nd quality	,,	16	0	0		17	0	0
Red Archangel and Onega, 3rd quality	,,	12	10	0		15	0	0
St. Petersburg, 1st quality...	,,	16	0	0		17	10	0
Do. 2nd ,, ...	,,	14	0	0		15	0	0
Gefle	,,	14	0	0		17	10	0
Wyburg	,,	12	0	0		13	10	0
Uleaborg	,,	12	0	0		13	10	0
Gothenburg	,,	14	0	0		17	10	0

COAL.

LEICESTERSHIRE.

The Nailstone Colliery Company, Leicester, quote. Price per Ton at Pit of 20 Cwt., with ½ Cwt. per Ton for wastage: —

Upper Main Seam.	s.	d.
Main Coal	7	6
Best Hard Steam (hand picked, as used by the Railway Companies)	6	0
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)	6	0
Fine Slack	0	6

Terms, net cash on 10th of month following delivery.

DERBYSHIRE.

The Manners Colliery Co., Ltd., of Ilkeston quote as follows, per ton at pit:

Kilburn Coal:	s.	d.
Best London Brights	9	9
Large Nuts (1½ to 3½)	9	6
Small Nuts (¾ to 1½)	6	0
Rough Brights	6	0
Peas (⅜ to ¾)	5	0
Slack	3	6
Smudge	2	0

Low Main (or Tupton) Coal:

Low Main Brights	7	6
,, ,, Nuts	7	3
Hards (Good Steam Coal)	8	0
Bakers' Nuts (1″ to 2″)	6	6
Slack	3	6

The Clay Cross Company's Collieries, Clay Cross, near Chesterfield, quote:—

	per ton at pit. s.	d.
Best Main Coal	10	6
Best Silkstone	10	0
Best House Coal	8	6
Best House Nuts	8	0
Treble Screened Cobbles	7	9
Best Cobbles	7	3

NOTTINGHAMSHIRE.

The Digby Colliery Co., Ltd., near Nottingham, quote per ton at pit:—

Digby Coal:

Steam.	s.	d.
Best Hand Picked Hard	9	0
Steam Hard	7	9
Hard Nuts	7	0

Gedling Colliery.

High Hazel.		
London Brights, 4 to 8 in. cube	12	0
Large Nuts, 2 to 4 in. cube	9	6
Small Nuts, ¾ to 2 in. cube	5	6

Steam.—Top Hard.		
Best Hard	9	0
Hard Steam	8	0
Cobbles	7	0

CHEMICALS AND OILS.

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square, Manchester, quote:

		£	s.	d.	
Acids:	Oxalic	0	0	2⅛	per lb.
	Picric, Crystals	0	0	11	,,
	Tartaric at Manchester	0	0	10⅞	,,

		£	s.	d.	
Acetate of Lime:	Brown at Manchester net	8	5	0	per ton.
	Grey ,,	11	0	0	,,
Alumina:	Alum, Lump, loose	5	5	0	,,
	,, ,, in casks	5	7	6	,,
	,, Ground, in bags	5	15	0	,,
	Sulphate of Alumina, 14%	4	10	0	,,
Ammonia:	Carbonate	0	0	3⅝	per lb.
	Muriate Grey f.o.b. Liverpool	24	0	0	per ton.
	Sal-ammoniac, Lump, 1sts, del^{d.} U.K.	42	0	0	,,
	,, ,, 2nds, ,,	40	0	0	,,
	Sulphate f.o.b. Liverpool	12	15	0	,,
Arsenic:	Best White Powdered net	12	0	0	,,
Bleaching Powder,	35% ,,	4	2	6	,,
Borax:	British Refined Crystal ,,	12	0	0	,,

Coal Tar Products:					
	Benzole, 50/90 % ,,	0	0	8	per gal.
	,, 90% ,,	0	0	9½	,,
	Carbolic Acid Crystals, 34/35° C. ,,	0	0	6⅞	per lb.
	,, ,, ,, 39/40° C. ,,	0	0	7⅛	,,
	,, ,, Liquid, 97/99 % ,,	0	0	9	per gal.
	,, ,, Crude, 62½% at 60° F. f.o.b. ,,	0	2	2	,,
	Creosote, ordinary good liquid ,,	0	0	1¼	,,
	Naphtha, Crude, 20 % at 120° C. ,,	0	0	3	,,
	,, Solvent, 90% at 160° C. f.o.b ,,	0	0	8½	,,
	,, ,, 95 % at 160° C. ,, ,,	0	0	9½	,,
	,, ,, 90 % at 190° C. ,, ,,	0	0	10½	,,
	,, Rectified, flash point over 73° F. f.o.b. ,,	0	0	11	,,
	,, Rectified, flash point over 100° F. f.o.b. ,,	0	1	0	,,
	Naphthalene, all qualities.				
	Pitch f.a.s. Manchester. ,,	1	13	0	per ton.
Copperas:	Green, in bulk ,,	0	12	6	,,
	,, barrels f.o.b. L'pool ,,	1	19	0	,,
	Cake ,,	1	2	6	,,
Copper:	Sulphate	23	0	0	,,
Cyanides:	98% minimum f.o.b. net	0	0	8	per lb.
Lead:	Acetate (Sugar) White, English	27	10	0	per ton.
	,, ,, ,, Foreign c.i.f. U.K	24	5	0	,,
	,, ,, Grey	21	0	0	,,
	,, ,, Brown at Manchester	16	10	0	,,
	Nitrate	23	0	0	,,
	Litharge, Flake	15	10	0	,,
	,, Powder	16	0	0	,,
	Red Lead, Genuine, c.i.f. London less 5%	15	10	0	,,
	White ,, ,, Dry ,, ,, ,,	16	15	0	,,
Naphtha (Wood):	Miscible, 60 o.p.	0	2	10	per gal.
	Solvent	0	2	7	,,
Potash:	Bichromate... delivered England	0	0	3	per lb.
	Carbonate, 90/92 % ... c.i.f Hull	18	0	0	per ton.
	Caustic, 75/80 % ,, ,,	20	10	0	,,
	Chlorate net	0	0	$3\frac{1}{16}$	per lb.
	Montreal in Store, Liverpool	35	0	0	per ton.
	Prussiate, Yellow net	0	0	$4\frac{15}{16}$	per lb.

	£	s.	d.	
Soda: Ash, Caustic, 48 %, Ordinary ... ,,	5	5	0	per ton.
,, ,, ,, Refined...... ,,	6	5	0	,,
,, Carbonated, 48 %............ ,,	5	10	0	,,
,, ,, 58 % (Ammonia Alkali) ....net	4	10	0	,,
,, Bleachers' Refined Caustic 50/52 % .... net	6	10	0	,,
Caustic, White, 77 %.............. ,,	10	10	0	,,
,, ,, 70 %.............. ,,	9	12	6	,,
,, ,, 60 %.............. ,,	8	12	6	,,
,, Cream, 60 %..... ....,	8	10	0	,,
Crystals, in bags	3	0	0	,,
,, barrels	3	7	6	,,
Acetate .... c.i.f. Hull net	16	10	0	,,
Bicarbonate, in 1 cwt. kegs............	6	15	0	,,
Bichromate......delivered England...	0	0	2¼	per lb.
Chlorate .... net	0	0	3 1/16	per lb.
Nitrate...ex quay Liverpool, ... ,,	11	0	0	per ton.
Phosphate	9	5	0	,,
Prussiate ....net	0	0	3⅝	per lb.
Silicate, Solution, 140° Tw.	4	10	0	per ton.
Sulphate (Glauber Salts)...............	1	12	6	,,
,, (Saltcake, 95%)...............	1	15	0	,,
Sulphur: Recovered	4	15	0	,,
Roll	6	15	0	,,
Flowers.................................	7	10	0	,,
Zinc: Sulphate	6	15	0	,,

MINERALS.

	£	s.	d.	
Barytes: Lump Carbonate, 90/92%	8	10	0	per ton.
Sulphate, No. 1, White	2	15	0	,,
China Clay: of various qualities for all purposes; prices from about 11/- to about 30/- per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid.				
Chrome Ore: Basis 50% c.i.f. British Ports...........	3	7	6	,,
Manganese: Lump c.i.f. Liverpool 10¼d.				per metallic unit.
Ochre: French JC .... f.o.b. Rouen, net	2	5	0	per ton.
,, JF	5	10	0	,,
Talc: (French Chalk).........c.i.f. Liverpool	3	10	0	,,

OILS, etc.

	£	s.	d.	
Aniline Oil ....net	0	0	4¾	per lb.
,, **Salt**.......... .... ,,	0	0	4½	,,
Castor Oil: French, 1st pressure, f.o.b. Marseilles less 1¼%.........	20	0	0	per ton.
English, 1st pressure, f.o.r. Hull, less 2½%...............	21	15	0	,,
Cocoa Nut Oil: Ceylon, ex store Manchester...............net	31	10	0	,,
Cochin, ex store Manchester.. ....net	33	0	0	,,
Cotton Seed Oil: Refined at Hull, less 2½% naked	14	17	6	,,
Edible...at Hull, less 2½% naked	15	7	6	,,
Glycerine: Crude, 80% ....net	31	0	0	,,
Linseed Oil: Raw... ..at Hull, less 2½% naked	13	10	0	,,
Boiled......at Hull less 2½% naked	14	10	0	,,
Starch: American Pearl...at Manchester, net	9	0	0	,,
Dextrine............ ,, ,,	18	0	0	,,
Farina................ ,, ,,	15	15	0	,,
Shellac: Standard TN orange spot		165/-		per cwt.
March delivery		145/-		,,
Turpentine: American.........at Liverpool	38	10	0	per ton.
Russian ....at Hull...net	18	10	0	,,

TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote:—

COLONIAL WOODS.

Timber.

		£	s.	d.		£	s.	d.
Quebec Square White Pine...	per cub. ft.	0	1	9	to	0	3	0
Quebec Waney Board Pine...	,,	0	2	8		0	3	9
St. John Pine, 18 in. average	,,	0	2	3		0	3	3
Lower Ports Pine..............	,,	0	1	3		0	1	8
Quebec Red Pine	,,	0	1	6		0	2	0
Quebec Oak, 1st quality	,,	0	2	9		0	3	3
Quebec Oak, 2nd quality ...	,,	0	1	6		0	2	6
Ash	,,	0	1	6		0	2	3
Elm	,,	0	3	0		0	3	9
Hickory	,,	0	2	0		0	2	6
Quebec Birch	,,	0	1	6		0	2	3
St. John Birch	,,	0	1	6		0	2	0
Birch Planks......................	,,	0	0	9		0	0	11
Spruce Spars	,,	0	0	10		0	1	0

Deals.

		£	s.	d.		£	s.	d.
1st quality Quebec Pine	per std.	22	10	0	to	32	10	0
2nd do. do.	,,	17	0	0		22	0	0
3rd do. do.	,,	11	10	0		13	0	0
St. John, N.B., etc., Spruce	,,	6	10	0		6	15	0
Lower Ports Spruce..	,,	6	0	0		6	10	0
Spruce Boards................	,,	5	10	0		6	0	0

UNITED STATES, etc., WOODS.

Pitch Pine.

		£	s.	d.		£	s.	d.
Hewn	per cub. ft.	0	1	3	to	0	1	8
Sawn	,,	0	0	10		0	1	6
Planks, Stowage	,,	0	0	10		0	1	0
Boards, Prime	per std.	12	10	0		16	0	0
Oak Timber	per cub. ft.	0	1	6		0	2	6
Oak Planks	,,	0	1	6		0	2	1
East India Teak..............	per load	12	0	0		15	0	0
Greenheart.....	,,	6	15	0		7	10	0

EUROPEAN WOODS.

Timber.

		£	s.	d.		£	s.	d.
Riga Redwood	per cub. ft.	0	1	9	to	0	2	3
Dantzic and Memel Fir, Crown	,,	0	2	1		0	2	6
Dantzic and Memel Fir, Middling	,,	0	1	9		0	1	11
Stettin	,,	0	1	9		0	1	11
Swedish	,,	0	1	2		0	1	4
Riga Whitewood	,,	0	1	3		0	1	6
Norway Mining Timber	,,	0	0	9		0	0	10
Dantzic and Stettin, etc., Oak..	,,	0	2	6		0	3	0
Norway Spars................	,,	0	1	2		0	1	9

Deals.

		£	s.	d.		£	s.	d.
Red Archangel and Onega, 1st quality	per std.	19	0	0		21	0	0
Red Archangel and Onega, 2nd quality	,,	16	0	0		17	0	0
Red Archangel and Onega, 3rd quality	,,	12	10	0		15	0	0
St. Petersburg, 1st quality...	,,	16	0	0		17	10	0
Do. 2nd ,, ...	,,	14	0	0		15	0	0
Gefle	,,	14	0	0		17	10	0
Wyburg	,,	12	0	0		13	10	0
Uleaborg	,,	12	0	0		13	10	0
Gothenburg	,,	14	0	0		17	10	0

SELECTED PATENTS.

Compiled expressly for this journal by **Messrs. Page and Rowlinson, Engineering Patent Agents, 28, New Bridge Street, London, E.C.,** and at Manchester.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton Buildings, Chancery Lane, W.C., at the uniform price of 8d.

NEW PATENTS APPLIED FOR.

When Patents have been communicated the names of the communicators are printed in italics.

28,310. T. H. C. Homersham, Bradford. Dec. 27th.—Improvements in and relating to syphon lubricators.

28,318. G. W. Deakin, Wolverhampton. Dec. 27th.—An automatic differential pump..

28,319. T. Taylor, Manchester Dec. 27th.—Improvements in steam boilers.

28,335. E. MacKay, Glasgow. Dec. 27th.—Improvements in engine indicators.

28,338. R. A. Griffiths and H. Mills, Handsworth. Dec. 27th.—Improvements in means for lubricating revolving shafts and spindles.

28,339. F. W. Hampshire, Derby. Dec. 27th.—Improved contrivances in connection with machines for delivering measured quantities of materials.

28,353. F. W. Hurd, Glasgow. Dec. 27th. Impvovements in coal-cutting machinery.

28,365. J. Harrop, Manchester. Dec. 27th.—Improved means for securing wheels to axles.

28,379. C. Bergmann, London. Dec. 27th.—An improved bearing for vertical shafts or spindles.

28,387. J. Coulter, London. Dec. 27th.—Improvement in automatic screw cutting and turning lathes.

28,388. J. C. Parker, London. Dec. 27th.—Improvements in steam generators.

28,390. E. S. Bond, Birmingham. Dec. 27th.—Improvements in transmission gear for high-speed engines.

28,401. F. C. Keith, London. Dec. 27th.—Improvements in rotary engines.

28,411. C. Bennett, Birmingham. Dec. 27th.—Improved means for propelling ships.

28,418. A. W. Death, Leicester. Dec. 27th.—Improvements in stop valves.

28,449. J. Wilkinson, London. Dec. 27th. Governing mechanism for turbines. (Date applied for, Feb. 23rd, 1904.)

28,450. J. Wilkinson, London. Dec. 27th. -Improvements in elastic fluid turbines. (Date applied for, Mar. 4th, 1904.)

28,451. J. Wilkinson, London. Dec. 27th. Improvements in and in connection with stuffing boxes for turbine shafts. (Date applied for, Mar. 8th, 1904.)

28,452. J. Wilkinson, London. Dec. 27th.—Governing mechanism for turbines. (Date applied for, July 23rd, 1904.)

28,463. B. J. B. Mills, London. Dec. 27th. An automatically closing cock or valve. (*Tony Blein and E. Sallé, France.*)

28,469. F. Mitchell and H. H. P. Seabrook, London. Dec. 27th.—Improvements in and relating to variable speed gears.

28,472. D. Mills, London. Dec 27th.—Improvements in air pumps.

28,475. E. E. Taylor, London. Dec. 27th.—Improvements in and relating to mechanical underfeed stokers.

28,477. L. E. Cowey, London. Dec. 27th.—Improvements in and relating to apparatus for indicating or recording speed.

28,485. P. R. J. Willis, Kingston-on-Thames. Dec. 27th.—Improvements in rotary steam engines. (*R. Buchanan, U.S.A.*)

28,530. T. K. North, London. Dec. 28th.—Improvements in boilers for the generation of steam.

28,538. A. A. C. Suggate, Manchester. Dec. 28th.—An improved stress-strain indicator.

28,539. E. Decauville, London. Dec. 28th.—An improved combined autoclave and hydraulic press. (Date applied for, Sept. 10th, 1904.)

28,541. T. G. Thompson, London. Dec. 28th.—Improvements in propellers. (Date applied for, Feb. 11th, 1904).

28,557. A. E. Bringemann, Sutton. Dec. 28th.—Economic crankless engine to be driven by compressed air, or by steam, or by a stored force, created by explosion.

28,571. The Warwick Machinery Company, Ltd., and F. Samuelson, London. Dec. 28th.—Improvements in and relating to steam turbines.

28,582. T. Delville, and E. Mennig, London. Dec 28th.—Means and apparatus for effecting the supply and exhaust of steam to and from steam engines working with slide valves.

28,625. E. P. A. Villette, London. Dec. 28th.—An improved system for rapidly stopping vessels travelling at full speed.

28,627. W. P. Thompson, London. Dec. 28th.—Improvements relating to turbine engines driven by combustible gases. (*E. Uhlenhuth, France.*)

28,681. J. Sharp, Glasgow. Dec. 29th.—Improvements in and relating to rotary exhausters and applicable to pumps or engines.

28,699. The Expansion Turbine Syndicate Ltd., and H. A. Buck, London. Dec. 29th.—Improvements in or relating to fluid pressure turbines or rotary engines.

28,761. G. R. Sisterson and G. Mitchell, London. Dec. 29th—Improvements in connection with cylinders and valves for locomotive and other engines.

28,768. P. Holtzmann, London. Dec. 29th.—Improvements in removable seats for pump valves.

28,771. F. J. Cole, London. Dec. 29th.—Improvements in steam boilers, superheaters.

28,772. F. J. Cole, London. Dec. 29th—Improvements in steam boiler superheaters.

RECENT SPECIFICATIONS.

VALVES.

J. Hopkinson and Co., Ltd., J. Hopkinson, and R. Kilburn, Huddersfield. May 28th, 1904.—Refers to improvements in the prior patent, No. 27798/1903, wherein is described a screw-down stop valve of the mushroom type, in which two valves are used, working in opposite directions and arranged on opposite sides of a seating-floor or partition. Said valves are connected together through their actuating mechanism, and are arranged to close on to the seating-floor from opposite sides thereof, and to nip said floor when closed, without straining the valve casing or bringing one-sided pressure to bear on the seating-floor by the closing means. In carrying out that invention we employed for one of the valves a tubular spindle connected to a bridge having a limited movement on fixed guides, the spindle of the other valve being arranged to pass through the aforesaid tubular spindle, and being connected to the bridge by a screw-threaded sleeve. In this construction, therefore, the connections are concentric. Now, according to the present invention, the same arrangement is employed for nipping the seating floor, but the concentric arrangement of spindles is dispensed with, and in lieu thereof, the valve spindles are passed out in opposite directions through lids on opposite sides of the casing so that no spindle passes through the thoroughfare in the partition as heretofore, and the spindles are actuated by connected gearing or by connected levers or rods and screw mechanism.

STEAM TRAP UNION.

Lancaster and Tonge, Ltd., and J. Butterworth, Pendleton, Manchester. Feb. 22, 1904. — Refers to a dirt arrester and union combined for use with steam traps and similar appliances. In order to prevent dirt or other solid matter entering the trap and damaging the working parts, a metal sieve is fitted in the centre of a specially constructed union attached to the inlet of the trap. The union is made of two metal plates or discs fastened together by four bolts, studs or screws with a metal sieve interposed between them. The bolt-holes in the plates are slotted so that one half of the union may be twisted on the other half sufficiently to allow the float in the trap to be set higher or lower, so as to compensate for wear. An inlet is provided in the edge of one half of the union as well as in the centre, so that either inlet can be used to suit the drain-pipe arrangements. Also by shifting one half of the union on the other, the inlet in the edge can be made to take up four different positions at right angles to each other, for the same purpose. Provision is also made for fitting a mud tap in the bottom edge of the union so that the dirt arrested by the sieve can be blown off.

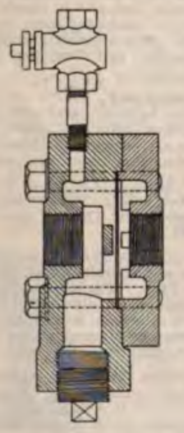


FIG. 2.

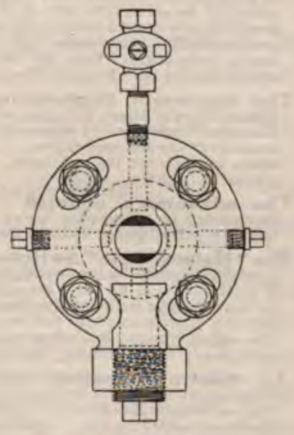


FIG. 1.

PRESSURE GAUGES.

Schaffer and Budenberg, Ltd., Manchester (communication from Schaffer and Budenberg, G.M.B.H. of Magdeburg-Buckau, Germany), Feb. 3rd, 1904. — The improvements relate to pressure and the like gauges, and their object is to construct certain parts that the wear and tear which has hitherto taken place between the quadrant and pinion or equivalent parts with resulting inaccuracy, shall be largely diminished. The frame, bracket or the like which are to support the different shafts are stamped out of sheet metal which need only be of sufficient thickness to possess the required structural strength, and is furnished at the proper point with a bush or bushes or liner of nickel, bronze, or other suitable bearing metal, secured in place within the stamping and bored to the required size, to form a bearing for the shaft. The holes in the stampings for the reception of the bushes may be formed in any desired manner, and are conveniently punched out at the same time as the stamping, these bushes are secured in place by screwing rivets, soldering, or other means. The drawings show views of a frame consisting of two parallel and oppositely disposed stamped plates.

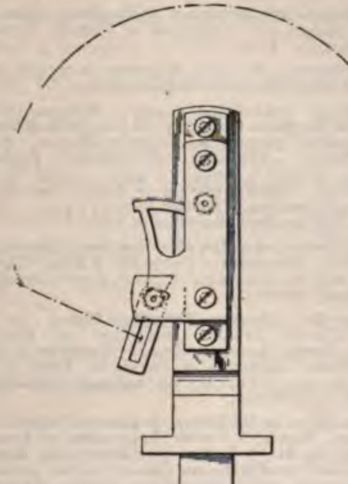


FIG. 1.

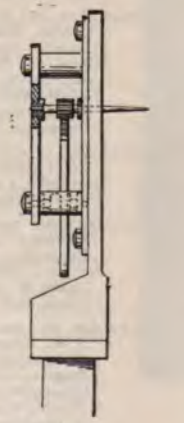
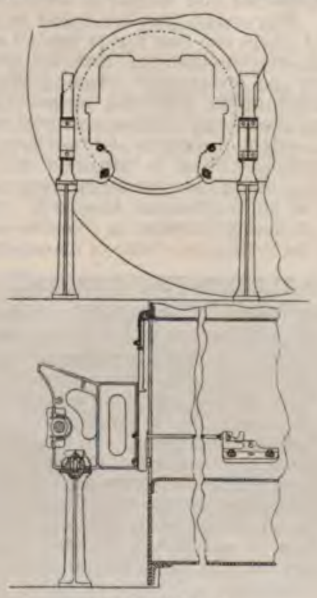


FIG. 2.

MECHANICAL STOKERS.

John Vicars, Thomas Vicars, and John Vicars, of Earleston, Lancs. Feb. 4, 1904.—The object of this invention is to construct and arrange mechanical stokers in a simple manner so that the stokers may be readily attached to, or detached from, a boiler, while a tight joint is always maintained between the stoker frame and the boiler when attached; and the stoker is free to move in or out with the expansion of the boiler. The back part of the stoker frame is provided with studs and set bolts adjustable in slots. These studs rest upon the furnace rings, or on the edges of the openings in the front plate of the boiler and support the weight of the back part of the stoker at this point. To keep the stoker frame closely in contact with the boiler front, the back parts of the frames are connected by long bolts to the brackets carrying the back bearers of the firebars. This avoids making holes in the front plate of the boiler for securing the stoker frame to. The front parts of the stoker frames are provided with slides which rest upon guides in uprights secured to the ground. The uprights have bolts which pass through slots in the stoker frames so that such frames are firmly secured to the uprights while allowing of longitudinal motion. At the same time these uprights support the greatest part of the weight of the stoker and fuel so that but little strain is on the boiler front.


FIGS. 1 AND 2.

CALENDARS.

From Messrs. W. H. Willcox and Co., Ltd., of 23, Southwark Street, S.E., we have received a "date remembrancer" for 1905, printed in two colours and suitable for hanging on the wall.

A substantial wall calendar received from Messrs. R. Y. Pickering and Co., Ltd., of Wishaw, incidentally calls attention to their railway motor carriages, samples of rolling stock, etc.

Messrs. Robert A. Thompson and Co., Ltd., Colonial publishers, wholesale exporters and importers of periodicals, of 5, Tudor Street, E.C., have issued an artistic card calendar printed in silver and blue on a dark red ground.

NEW PUBLICATIONS.

"THE METRIC FALLACY."

By Frederick A. Halsey, and "The Metric Failure in the Textile Industry." By Samuel S. Dale. D. Van Nostrand Company, New York. E. and F. N. Spon. 4s. 6d. net.

This emphatic protest against the introduction of the Metric system is the outgrowth of a paper presented about two years ago to the American Society of Mechanical Engineers. Without entering into any species of partisanship we cannot avoid admiring the vigour and enthusiasm with which the writers attack their subjects. They remark that Anglo - Saxon nations are the only ones that have ever dealt with the subject of weights and measures in a rational manner, and "with their system of weights and measures as a foundation, the English-speaking people have built up the greatest commercial and industrial structure the world has known. This system they are asked to abandon for the benefit of others at a cost that is beyond estimate, and for compensating advantages that to themselves are wholly trivial and imaginary." Among others the work aims at establishing the following propositions : That as shown by the experience of other countries, the changing of a nation's system of weights and measures is a task of enormous difficulty, and is attended by widespread confusion ; the adoption of the metric system involves the destruction of all mechanical standards ; and that the prosperity of foreign trade in nowise requires the adoption of the system as a basis of manufacture.

"ALTERNATING CURRENTS."

By Alexander Russell, M.A., M.I.E.E. Volume I. Cambridge Physical Series, C. J. Clay and Sons. 12s. net.

The desirability of collecting together and examining the mathematical theorems which electricians constantly utilise, has been accentuated by the rapid advancement that has been made in the application of alternative currents to industrial purposes. In this connection, Mr. Russell's work when completed, should prove invaluable to the working electrician or the advanced student ; the present volume opens with a résumé of the theorems and formulæ in the sciences of electro-statics, electro-dynamics, and magnetism ; then follow a few chapters dealing with induction and capacity, and the methods by means of which the capacities of polyphase cables and overhead wire can be calculated. Other sections of the work deal with the test room methods of measuring power ; some problems in two phase theory, demonstrating how the theorems of solid geometry can be applied in this case ; the main problems in the theory of phase indicators and induction type watt-hour meters are stated and approximate solutions are given. Succeeding chapters are devoted to, Rotating Magnetic Fields, Gilding Magnetic Fields ; the Magnetic Field round Polyphase Cables, Losses in Single Phase and Three Phase Cables ; Eddy Current Losses, and the Method of Duality. The book is well illustrated.

BOOKS RECEIVED.

The Commission of H.M.S. *Fox*, East Indies Station, 1901-04. By F. E. Nobbs and W. T. Berger. The Westminster Press (Gerrards, Ltd.). 4s. net.

Laboratory Notes on Practical Metallurgy. By Walter Macfarlane F.I.C. Longmans, Green and Co. 2s. 6d.

Astronomy without a Telescope. By F. W. Maunder. W. Thacker and Co.

A Short Introduction to the Theory of Electrolytic Dissociation. By J. C. Gregory. Longmans, Green and Co. 1s. 6d

The Fan, including the Theory and Practice of Centrifugal and Axial Fans. By Charles H. Innes, M.A. The Technical Publishing Co., Ltd. 4s. net.

The Construction of Cranes and other Lifting Machinery. By Edward C.R. Marks. The Technical Publishing Co., Ltd. 3s. 6d. net.

NEW CATALOGUES.

Bulletin No. 9 of the Brush Electrical Engineering Co., Ltd., is devoted to Induction Motors, and contains some excellent full-page half-tone illustrations.

Messrs. A. Gallenkamp & Co., Ltd., of 19 and 21, Sun Street, Finsbury Square, E.C., have been appointed sole agents for the Kryptol Gesellschaft, Ltd., of Berlin, for their "Kryptol" Heating Apparatus. We are told that "Kryptol" is a new resistance material for producing heat by electricity. It is partly composed of a mixture of graphite, carborundum, silicates and clay, in granular form. When subjected to an electric current it becomes hot, and is capable of producing any desired temperature up to, or exceeding, 2,000 deg. C. or 3,600 deg. F. It is claimed that "Kryptol" will endure a temperature of 3,000 deg. C. Price list "K" describes and illustrates some applications of the "Kryptol" Heating Apparatus.

The Sturtevant Engineering Company, Ltd , of 147, Queen Victoria Street, E.C., call attention to their catalogue "The Compleat Controller" by means of a folding letter card, giving the contents of the abridged edition. For the convenience of those who desire to write for this catalogue, a detachable order postcard is stapled to the letter card.

The advantages claimed for the Oliver Typewriter are enumerated in a four-page leaflet issued by the Oliver Typewriter Company, of 75, Queen Victoria Street, E.C.

The "Holmes-Page" Switches are illustrated and described in a catalogue issued by the sole patentees and manufacturers, Messrs. J. H. Holmes and Co., of Newcastle-on-Tyne. The left-hand pages of this catalogue are devoted to descriptions of the different types of switches manufactured by the firm, each of which is illustrated on the opposite page. Recording voltmeters and ammeters are dealt with in a catalogue entitled "Recording Instruments (Patent)."

An illustrated leaflet, describing the Pridmore Automatic Copying-press, is issued by the Trading and Manufacturing Company, Ltd., of Temple Bar House, Fleet Street, E.C. It is claimed that the double self-adjusting screw (which constitutes the difference between the Pridmore Press and an ordinary one with a wheel handle), effects rapidity of action with ease of operation, and great pressure at the cost of slight exertion.

MEETINGS FOR THE ENSUING WEEK.

FRIDAY, JAN. 13—Institution of Electrical Engineers (Manchester Students' Section) ; Meeting in the Municipal School of Technology ; 7 30 p.m. Paper by Mr. A. E. Jephson, "Electric Heating."—Tramways and Light Railways Association : Meeting at the Society of Arts ; 8 p.m. Paper by Mr. H. M. Sayers, "Overhead Equipment."—Junior Institution of Engineers : Meeting at the Westminster Palace Hotel ; 8 p.m. Professor Vivian B. Lewes will lecture on "The Theory of the Incandescent Mantle."—Institution of Civil Engineers (Students' Section) : Great George Street, Westminster : 8 p.m. Mr. James Swinburne will lecture on "Theory of Electricity and Magnetism."

SATURDAY, JAN. 14—Manchester Association of Engineers : Paper by Mr. R. M. Nellson, "A Comparison of Different Types of Steam Turbine."

MONDAY, JAN. 16—Institution of Electrical Engineers (Newcastle Local Section) : Meeting, Durham College of Science.

TUESDAY, JAN. 17 Royal Institution : 5 p.m. Professor Miall's Course. First Lecture.—University of Liverpool Engineering Society : 5.30 p.m. Paper by Mr. Frederick Hughes, "Filtration of Water."—Institution of Electrical Engineers (Manchester Local Section) : 8 p.m. Paper by Mr. H. M. Wilson, "Electric Driving in Textile Factories."—Royal Colonial Institute, Whitehall Rooms : 8 p.m.—"Fiscal Preference from an Australian Point of View,"

WEDNESDAY, JAN. 18—Institution of Electrical Engineers (Birmingham Local Section) : Birmingham University, 8 p.m.—Chemical Society : 5.30 p.m.—Geological Society : 8 p.m.—Society of Arts : Ordinary Meeting.

THURSDAY, JAN. 19—Royal Society: Burlington House : 5 p.m. Professor Churton Collins.—Institution of Electrical Engineers, Leeds Local Section : Yorkshire College. 8 p.m.—Dundee Institution of Engineers : Paper by Mr. David R. Cowpar, "The Marine Engineer ; his training duties, and responsibilities."

FRIDAY, JAN. 20—Institution of Mechanical Engineers : Storey's Gate, S.W., 8 p.m. ; Papers ; —"Some Impressions of American Workshops," by Mr. A. J. Gimson ; "Waterworks Pumping Engines in the United States and Canada," by Mr. John Barr ; "Some Features in the Design and Construction of American Planing Machines," by Mr. Archibald Kenrick, Jun. ; "Engines at the Power Stations, and at the St. Louis Exhibiton," by Mr. Alfred Saxon.—Royal Society : Burlington House, W., 9 p.m. : Paper by Sir J. Dewar "New Low Temperature Phenomena".—North-East Coast Institution of Engineers and Shipbuilders, Newcastle : Paper by Mr. J. Little, "Petrol Motor Cars",—Electric Harmonic Smoker : Holborn Restaurant, 8 p.m.

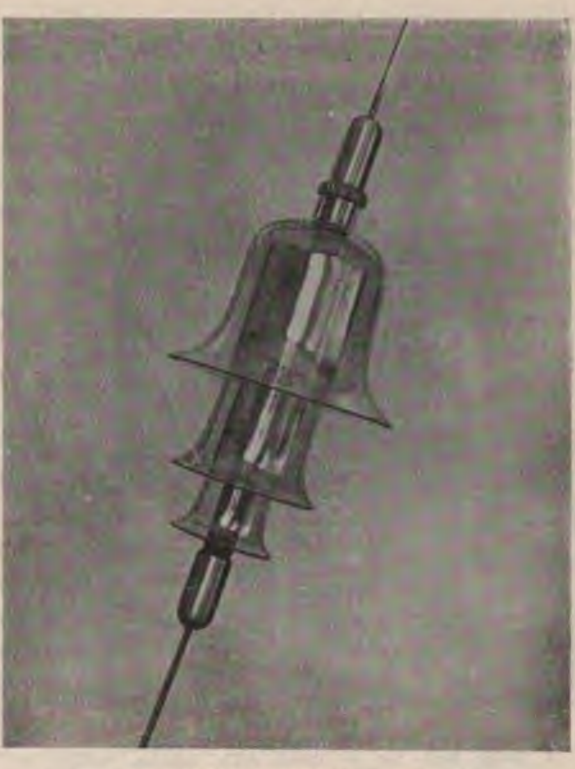
PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

VOL. VI. LONDON, FRIDAY, JANUARY 20, 1905. No. 19.

The Offices of "Page's Weekly," Wednesday, Midnight.

IN my last notes I incidentally mentioned the fact that a layer of grease upon the water side of the heating-surface was "far worse" than the deposit of ordinary scale. From one or two inquiries which have reached me in consequence, I am induced to devote a little space to the amplification of this statement, which is indeed of much importance to users of feed-water heaters in which the exhaust steam is in actual contact with the water to be heated. The experiments of M. Hirsch upon the varying rates of transmission through plates and tubes under different conditions throw much light upon a subject to which I am convinced that we pay too little attention. The transmission through the metal, and from the metal to the water, takes place very readily, so that with a very small difference between the temperature of the iron and that of the water, heat passes in large quantities freely, always providing that there are no thick incrustations of scale or coatings of oily matters. With clean plates, when the temperature of the water rises in any boiler, the difference between plate and water does not increase in proportion. Thus, in an iron firebox with plates of three-eighths of an inch in thickness, the water being at 356 deg. F., and evaporating at the rate of 40 pounds per square foot of surface per hour, the difference of temperature between plate and water should be theoretically 212 deg. F, but the temperature of the iron plates never reaches 568 deg. M. Hirsch satisfied himself that, providing only the metal be sound and in direct contact with the water, there is no danger of overheating whatever may be the rate of evaporation. It is far otherwise, however, when the interior surfaces are coated with a layer of grease. By



THE LODGE FOG-DISPERSING APPARATUS.

An aerial bell insulator employed to fix the end of an insulating discharging wire under tension, by means of a wire rope tie. (*See page* 113.)

means of fusible plugs of alloys having different melting points disposed over the surface of the plates under experiment, he was able to estimate the temperature of the plate under the varying conditions.

In his inquiries into the effects of a coating of grease, he began by covering the interior surface of the plate with mineral oil, which was then wiped off, leaving a greasy layer of inappreciable thickness, but sufficient to prevent the actual contact of water. Using distilled water he found that even with very moderate heating, the exterior surface of the plate reached temperatures considerably higher than when the surface was clean. Thus, with an evaporation of thirty pounds per square foot per hour, the plate was overheated 122 deg. F.; and with an evaporation of fifty pounds per square foot 176 deg., the temperature of the fire side of the plate being 392 deg. above that of the water. Other experiments tended to show that with very moderate rates of evaporation the temperature of the plate had been not less than 842 deg. F. for the greater part of its thickness.

FOG—DISPERSAL APPARATUS—THE LABORATORY EXPERIMENT.

A large bell-jar is filled with smoke, which is electrically treated as described on page 113. The drawing shows the appearance of the smoke whilst dispersing. The smoke forms into flakes, and is quickly deposited on the point and sides of the jar.

"A great change takes place in all descriptions of iron and mild steel at a temperature of about 630 deg. F., and they either become weak, or so brittle as to be easily broken by a sudden stress or blow, without bending." This sentence, quoted from Hutton, needs no amplification in connection with the results given above.

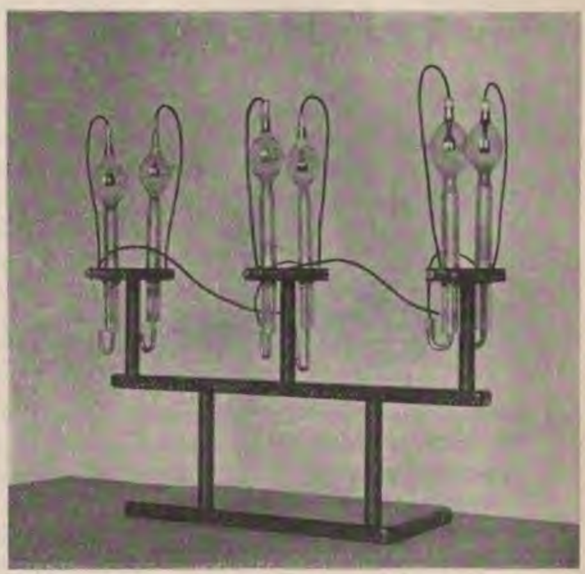
The effect of a deposit of grease upon the crown-plate of a locomotive firebox made of steel plates has, within my own experience, resulted in the bulging downwards of the plate in a series of pockets between the bolt-stays; a sufficiently disconcerting sight with an incandescent mass of fire 10 in. or 12 in. thick in full swing, and a steam pressure within of 160 lb. per square inch.

M. Hirsch imitated the black patches of partly decomposed fatty matter found adhering to boiler plates by greasing the bottom of a tinned saucepan with mineral lubricating oil and heating it over a slow fire without water. The bottom was then found to be covered with a black coating, to which water would not adhere. The saucepan was then filled with water and heated over the furnace. After boiling for one minute, part of the bottom of the saucepan was seen to become red hot, and this soon spread over the whole of the area exposed to the heat of the furnace. Evidently the bottom of the saucepan was never wetted, and the water assumed the spheroidal condition. This experiment was repeated several times with different intensities of fire, and it was found that with heat corresponding to an evaporation of about 54 lb. per hour, the colour of the bottom was a bright orange red.

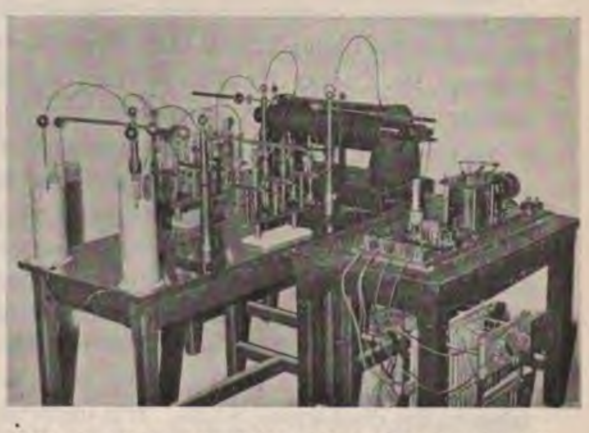
Flaws or laminations in firebox and furnace plates are also very liable to give rise to local overheating. With an artificially laminated plate, temperatures beyond 842 deg. F. were attained with a rate of evaporation equal to 50 lb. per square foot per hour. On the other hand, properly fitted lap rivet-joints, with the two surfaces in actual metallic contact, transmitted the heat exactly as a single plate of thickness equal to the two plates forming the lap-joint would have done; except when the evaporation was pushed to 60 lb. per square foot of heating surface, when the temperature of the plate next the fire was found to be over 392 deg. F.

There are, of course, several different types of feed-water filters claiming to efficiently separate the oil which comes over with the exhaust steam when this is mixed with the feed water; but prevention is better than cure, and feed-water heaters, where the exhaust steam is on one side of the tubes, and the water to be heated on the other, are safer, and, in my opinion, preferable in every way, where circumstances admit of their being used.

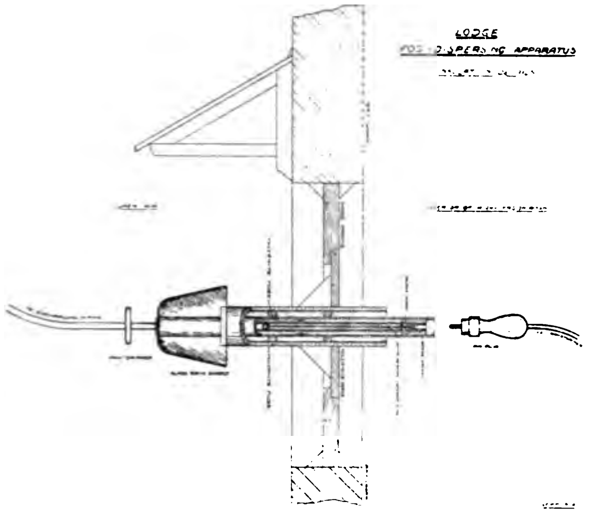
Being assured that many of my readers would welcome some further details of the apparatus by which Sir Oliver Lodge seeks to dispel fog, I wrote that gentleman on the subject and was courteously referred by him to an article by his assistant which recently appeared in The World's Work. Sir Oliver also placed at our disposal the accompanying photographs. According to our contemporary he "rediscovered in 1884 the fact that by discharging electricity into a smoky or dusty atmosphere, the small particles of which the smoke is composed tend to coalesce into flakes, in the space around the points of discharge, and to be deposited on all opposing surfaces." This tendency as applied to the dispersal of fog is illustrated in a laboratory experiment, a large glass bell-jar being used to contain the artificially-produced fog, while a small current at a very high potential is furnished by a Wimshurst machine. One terminal of the machine is connected up to a sharp point inside the bell-jar, while the other is connected to the metal plate underneath representing the earth. When the current is turned on, the particles of smoke at once form into long streamers which are deposited on the discharging rod and on the sides of the jar, leaving the air perfectly clear.



THE LODGE FOG-DISPERSING APPARATUS.
A set of mercury rectifiers on insulating stand.



PART OF SMALL EXPERIMENTAL APPARATUS NOW IN USE IN SIR OLIVER LODGE'S LABORATORY, AT THE UNIVERSITY, BIRMINGHAM.
A large induction coil, a battery of rectifiers, and two Leyden jars, which act as capacities.



A WALL INSULATOR.

Being the arrangement found necessary for carrying the high-tension leads through a wall, from the high-tension rooms to the open air.

This method of dispersing fogs, though easily performed in the laboratory, has not come into practical use on a large scale, owing to the difficulties which arose in the production of a direct current of sufficiently high potential to spit off readily from the discharging points into the atmosphere. The writer shows that until recently it has been impossible to use a dynamo for this purpose owing to there being no continuous current dynamo capable of working at the high potential necessary. Now, however, Mr. Cooper Hewitt's mercury vapour rectifier has been found capable of working at very high potentials, and its use enables alternating dynamos and transformers to be employed; their current being rectified so as to maintain a continuous discharge in one direction. The current supplied by the dynamo is first transformed up to the potential required, then passed through a series of rectifiers, whence the positive and negative wires are taken to the discharging points. It is important that the electrical discharge should take place in the freest possible manner; otherwise an unnecessary strain is thrown on to the rectifiers and insulation. The discharging wires may be arranged with one pole earthed and the other erected on a mast or building, with suitable means for discharging electricity, such as a flame, or a number of points; or in some cases two aerial wires might be used—one for the positive discharging stream and the other for the negative, with a number of points on each. This method of using two aerial wires would be the most suitable arrangement for depositing fume in the flues or settling chambers of factories and for clearing fogs within a limited area. It would be applicable to navigable rivers, subjected to natural fogs. On each bank barbed wires might be suspended parallel to the river and at a safe height from the ground; then positive electricity could be discharged from one side and negative electricity from the other. It is essential that the insulation throughout should be as thorough as possible. Further developments in this field will be watched with the greatest interest.

The agitation to remove the Royal Agricultural Show from Park Royal, and revert to the old custom of holding the show in a different town each year, has not succeeded. At the adjourned meeting of the Society held a few days ago, Lord Middleton announced that Park Royal would again be the venue. The date fixed is June 27th and following days, and it is satisfactory to note that of the £10,000 guarantee required, the greater part has already been subscribed. It appears that the Great Western Railway offered to guarantee the balance of the £10,000 required on condition that the Company received shares in respect of any payments it was called upon to make under such guarantee, but the offer was declined. Statistics show that over a period of forty-one years the Society lost on its annual show a sum of £54,590, and over sixty-five years an average of £829 per annum. The decision to hold another show at Park Royal was not unanimous, and expressions of regret at the abandonment of the country meetings were heard.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

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Editorial.—*All communications intended for publication should be written on one side of the paper only, and addressed to "The Editor."*

Any contributions offered, as likely to interest either home or foreign readers, dealing with the industries covered by the Weekly, should be accompanied by stamped and addressed envelope for the return of the MSS. if rejected. When payment is desired this fact should be stated, and the full name and address of the writer should appear on the MSS.

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Correspondence *is invited from any person upon subjects of interest to the engineering community. In all cases this must be accompanied by full name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

The Editor does not hold himself responsible for the opinions expressed by individual contributors, nor does he necessarily identify himself with their views.

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New Copy for Advertisements,

Alterations, &c., intended for insertion in the current week's issue must be delivered **not later than 4 p.m. on Monday.** If proofs are required the copy and blocks should reach us several days earlier.

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NEWS ITEMS.

The number of Chinese actually employed in the Rand mines to date is 23,052, less 8 dead. On January 10th, the total number of Chinese in the country was 25,092. Mr. Lyttelton's report gives the following returns showing incidentally the steady growth of Chinese employment: June, 1904, 1,004; July, 1,388; August, 4,945; September, 9,020; October, 12,965. In the latter month, 14,525 whites and 78,491 coloured employees were engaged in the gold-mining industry of the Transvaal.

It is stated that a delay of serious importance has occurred in the completion of the Great Northern and Strand and Piccadilly and Brompton connection of the tube railways of the metropolis, owing to a disagreement between the promoters and the London County Council.

At the meeting of the Institute of Marine Engineers on Monday evening, the President, the Hon C. A. Parsons presented the "Denny" gold medal to Mr. R. Balfour, for his paper on "Refrigerating Appliances on Board Ship." The President said that the subject of Mr. Balfour's paper was an interesting and important one, and he himself had devoted not a little attention to the problem.

The Stirling Boiler Company, Ltd., and the Stirling Company, of U.S.A., have come to an arrangement, whereby litigation which had been pending between the two companies for nearly a year has been satisfactorily settled. We understand that the Stirling Boiler Company, Ltd., have acquired all the British and European patents of the American company, and in future all boilers sold in these markets will be of British manufacture. Both the American 4-drum type and the British 5-drum Stirling boiler will be sold in this country. The Stirling Boiler Company, Ltd., have large and well-equipped works at Motherwell.

Royal College of Science and Royal School of Mines.

The President of the Board of Education has appointed the Right Hon. R. B. Haldane, K.C., M.P., to be chairman of the departmental committee which is inquiring into the present and future working of the above-named institution in place of Sir Francis Mowatt, G.C.B., late Secretary to the Treasury, who, while remaining a member of the committee, has resigned the chairmanship owing to complications having supervened on his illness which were not previously anticipated.

The Training of Apprentices.

Some time ago we chronicled the introduction of a new scheme by Messrs. Richardsons, Westgarth and Co., Ltd., at their Hartlepool works, whereby each apprentice on reaching a certain standard for time-keeping, perseverance, ability, and good conduct in the shops, and for passing examinations at the evening classes, obtained an increase in his weekly pay for the whole year.

We are pleased to hear that the scheme shows continued success. Last year the increase in the boys attaining the minimum standard was for time-keeping 27 per cent., perseverance and good conduct 31 per cent., and for passing examinations 48 per cent. The improvement is obviously due to the greater interest taken by the boys in their work, as they now realise that progress and promotion depend entirely on their own efforts. The foremen are also brought into closer association with the boys, The advances last year range from sixpence to one shilling and twopence per boy per week, or a total of about £170 for the year. The details of the scheme, it will be remembered, were arranged by Mr. D. B. Morrison.

Sir W. H. Preece on Water-Finding.

Since our last issue, Sir W. H. Preece has entered into the Times discussion on Water-Finding, and it is interesting to note that he negatives the suggestion that dowsing is an effect of electricity. "The proper use of electric currents," he writes, "can show the existence of water and of metallic veins, but the so-called 'divining-rod' has nothing whatever to do with electric or magnetic phenomena as far as I can conceive. I have come to the conclusion that it is mechanical vibration, set up by the friction of moving water, acting upon the sensitive ventral diaphragm of certain exceptionally delicately framed persons. That moving water restrained by gravel, hose, pipes, piers, sluices, walls, etc., sets up vibrations is patent to any one who will stand on the pier of a bridge, or place his finger on a hose or tongue on a pipe through which water is flowing. I have even heard sounds emitted by small iron pipes. Telegraph wires hum through the similar friction of moving air. Sea-sickness is probably an exaggerated effect of the same phenomena, and those who patronise the switchback owe their excitement probably to the same cause. Earthquakes produce the same effect."

THE TURBINE STEAMER LOONGARA.

One of a series of illustrations of Parsons' turbine ships shown by the Hon. Charles A. Parsons at the Institute of Marine Engineers. The *Loongara* is the first ocean-going turbine steamer, and was built by Messrs. Denny and Brothers, of Dumbarton, for the Union Steamship Company of New Zealand. She made over 20 knots on her trial trip.

Labour in December.

Board of Trade statistics, just issued, show that employment in December was dull on the whole, and rather worse than a month ago. A further decline took place in the engineering trade. On the other hand some improvement took place in the coal trade, and also in the iron and steel, and shipbuilding.

The following table shows the average weekly number of shifts worked and the changes in the number of workpeople employed at 244 iron works in Great Britain :—

District.	Numbers employed in week ended		Average Number of Shifts worked per man in week ended	
	Dec. 17th, 1904.	Dec. 19th, 1903.	Dec. 17th, 1904.	Dec. 19th, 1903.
Northumberland and Durham ...	9,664	9,291	5·46	5·30
Cleveland	6,434	7,301	5·45	5·60
Sheffield and Rotherham	16,254	15,739	5·65	5·62
Leeds, Hull and other Yorks. Towns	3,338	3,157	5·42	5·35
Cumberland, Lancashire and Cheshire	11,513	10,711	5·17	5·01
Staffordshire	9,678	9,407	5·38	5·27
Other Midland Counties	4,250	4,505	5·12	5·13
Wales and Monmouth	10,269	8,634	5·68	5·65
England and Wales	71,400	68,745	5·47	5·41
Scotland	13,547	13,296	5·52	5·29
Total	84,947	82,041	5·48	5·39

It will be seen that in the week ending December 17th, the number of workpeople employed was greater in every district (except Cleveland and the other Midland Counties) than in the corresponding week of 1903. The greatest proportionate increase was in South Wales and Monmouthshire, where the numbers employed showed a rise of about 19 per cent. On the average 5·48 shifts were worked by each person during the week ended December 17th, 1904, as compared with 5·39 in the corresponding week of 1903. The district showing the highest average was South Wales and Monmouthshire, where 5·68 shifts per man were worked. On the other hand only 5·12 shifts per man were on the average worked in the other Midland counties.

Iron and Steel Trade Outlook.

The year 1905 opens with a decidedly improved feeling and better prospects for the iron and steel trade on both sides of the Atlantic. The last returns of the Board of Trade indicate a growing improvement in our export trade, but from the complaints of want of employment in many parts of the country it is to be feared that the after effects of the South African war are still felt in many branches of trade, whilst dearer money has affected the expenditure of our great municipalities, and the many new enterprises which otherwise would be undertaken. During the present war between Russia and Japan several departments of the trade are being benefited ; but it is reasonable to expect that peace would lead to a still greater expansion of trade both in Japan and China. There is undoubted improvement in the condition of many of those countries with which we trade, India, China, Australia, New Zealand, South Africa, Argentina and Canada all sending us better accounts, which it is to be hoped, says the annual circular of Messrs. William Fallows and Co., will manifest itself in increased trade during the year ; but it may be that our patience may be tried before all the anticipations of the more sanguine among us are fully realised.

Direct Railway Service to West Cornwall.

The Great Western Railway Company have opened a section of line between Newquay and Perranporth, thus completing the connection between the former watering place and Chacewater, and providing a direct service to Truro and West Cornwall generally.

On Monday afternoon the Tramways and Light Railways Association paid a visit to the works of the Central London Railway. A special car was provided to convey the party to Shepherd's Bush, where the many interesting features of the power house and car sheds were inspected under the guidance of members of the Central London engineering staff.

Standard Specification for Portland Cement.

The committee responsible for the specification on Portland Cement, which forms the latest publication of the Engineering Standards Committee (see page 132), was constituted as follows :—

Mr. Wm. Matthews, C.M.G. (Chairman), representing the Crown Agents for the Colonies) ; Mr. C. Colson, C.B., representing the Admiralty ; Mr. Lewis Solomon, representing the Royal Institute of British Architects ; Mr. Bertram Blount, representing the Institute of Chemistry ; Mr. Maurice Fitzmaurice; C.M.G., representing the London County Council , Sir John Mowlem Burt (John Mowlem and Co.) ; Messrs. H. W. Anderson, H. K. G. Bamber, E. W. Brooks, B. P. Ellis, O. L. Ellis, Francis Fox, Howard H. Humphreys, A. Lyster, J. A. McDonald, Charles S. Meik, V. de Michele, E. E. Pearson, W. H. Roberts, W. W. Squire, J. Warbrick, C. H. Watson, M. F. G. Wilson, and G. W. Yourdi.

Andrew Carnegie Research Scholarship.

The following has been issued by the Iron and Steel Institute: A Research Scholarship or Scholarships, of such value as may appear expedient to the Council of the Iron and Steel Institute from time to time founded by the Mr. Andrew Carnegie (president), who has presented to the Iron and Steel Institute sixty-four $1,000 Pittsburg, Bessemer and Lake Erie Railroad Company 5 per cent. Debenture bonds for the purpose, will be awarded annually, irrespective of sex or nationality, on the recommendation of the Council of the Institute. Candidates, who must be under thirty-five years of age, must apply on a special form before the end of February to the Seccetary of the Institute.

The object of this scheme of Scholarships is not to facilitate ordinary collegiate studies, but to enable students, who have passed through a college curriculum or have been trained in industrial establishments, to conduct researches in the metallurgy of iron and steel and allied subjects, with the view of aiding its advance or its application to industry. There is no restriction as to the place of research which may be selected, whether university, technical school, or works, provided it be properly equipped for the prosecution of metallurgical investigations.

The appointment to a scholarship shall be for one year, but the Council may at their discretion renew the Scholarship for a further period instead of proceeding to a new election. The results of the research shall be communicated to the Iron and Steel Institute in the form of a Paper to be submitted to the Annual general meeting of members, and if the Council consider the Paper to be of sufficient merit, the Andrew Carnegie Gold Medal shall be awarded to its author. Should the paper in any year not be of sufficient merit, the Medal will not be awarded in that year.

CORRESPONDENCE.

Delhi-Bombay Motor Reliability Trial.

Hogarth Lane,
Chiswick, London, W.

To the Editor of PAGE'S WEEKLY.

SIR,—We understand that tyre troubles were the principal cause of failure in the Delhi-Bombay Reliability Trial; at least, our representative has cabled us that the Thornycroft car lost no marks except for tyre troubles, but that these latter caused it to be unplaced in the List of Awards.

Faithfully yours,
JOHN I. THORNYCROFT AND CO., LTD.

Long Distance Power Transmissions.

Beesfield,
Farningham, Kent.

To the Editior of PAGE'S WEEKLY.

DEAR SIR,—In connection with some extracts which you published from my paper, read before the Liverpool Engineering Society, entitled "Long Distance Transmission of Power from High Head Falls," Mr. Norman Carmichael, of The Highland (Kootenay B. C.) Mining Company, Ltd., has sent me the attached interesting letter.

Yours sincerely,
E. KILBURN SCOTT.

DEAR SIR,—I beg to acknowledge your kindness and courtesy in sending me a copy of your valuable paper on "Long Distance Transmission of Power," which I have read with much interest.

I was much struck with reading the review of your paper in PAGE'S MAGAZINE, with the very practical manner in which you had treated the subject, and it was for purposes of study that I desired the full text. My interest lies more particularly in the primary part of power transmission; the conveyance and application of the water to the wheel as we have to do with it in nearly all our mining operations in this part of the world.

It is not usual here to bury the pipe line, on account of cost, and the rocky nature of the mountain sides usually renders it difficult. At a stamp mill near Nelson, of which I had charge, we had a pipe line 2,000 ft. long, bringing water to the wheels under a 680 ft. head, the diameter of the pipe being 12 in., 10 in., and 8 in., the upper 500 ft. being slip joint, and the lower 1,500 ft. being flange joints.

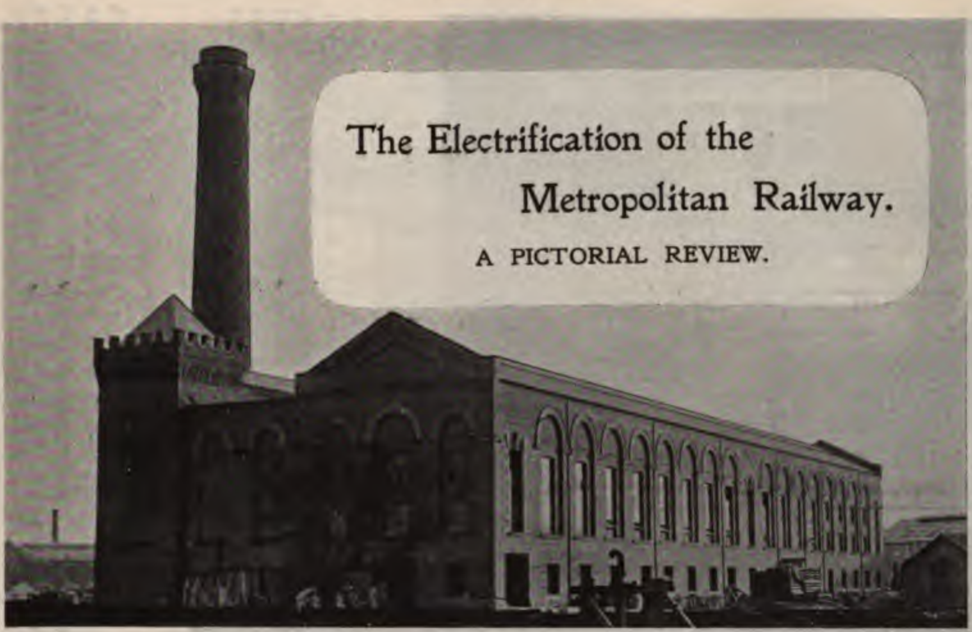
During the winter of 1902–3, we had a severe spell of weather for a fortnight the mercury hovering around zero, and we noticed the power getting shorter as the cold snap continued. By tapping the line it was easy to discover that ice was forming round the inside of the pipe, but no serious trouble was anticipated, and the water was kept running through the pipe. Then came a sudden thaw with heavy warm rain, and this loosened the ice round the inside of the pipe; the ice eventually breaking away and choking the pipe at the point where it was reduced from 12 in. to 10 in., and completely stopped the water.

This happened at a point about 200 ft. from the penstock, or about 500 ft. vertically above the nozzle, and at about midnight I was on my way up to the penstock to find out what was the matter when the jam broke, and ice, water and all came tearing down the pipes with an almost deafening roar. Fortunately the valve at the wheel was open, and some of the pressure was relieved no damage was done there; but on reaching the point where the jam had taken place, I found that about 60 ft. of the pipe had collapsed with the vacuum. The relief valves had failed to act, as it was impossible to keep them from freezing up, this was the only occasion in four years experience that their services were required. A few clamps and two lead joints made the pipe right, and there has never been any trouble with it since.

Yours faithfully,
NORMAN CARMICHAEL.

The Electrification of the Metropolitan Railway.

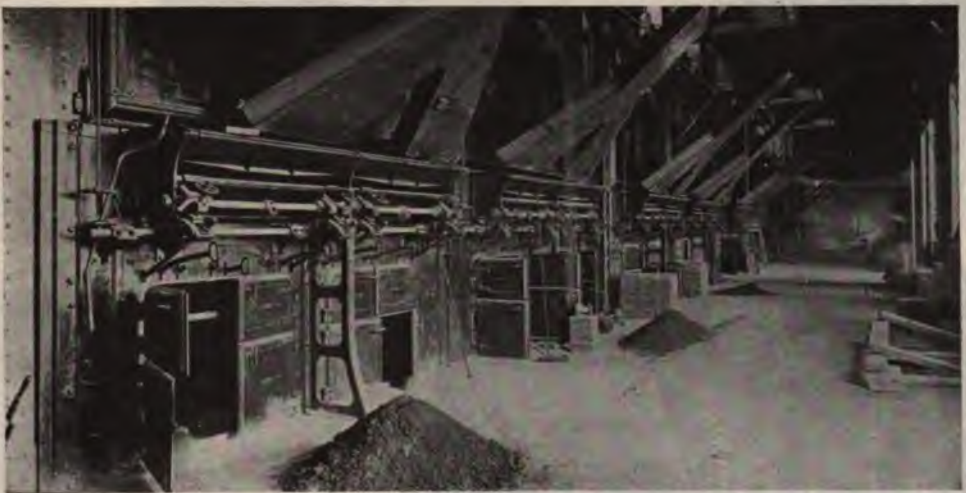
A PICTORIAL REVIEW.



THE NEASDEN GENERATING STATION.

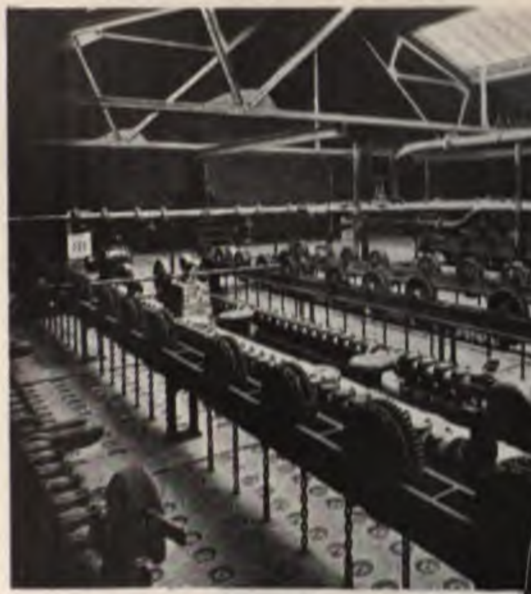
The Metropolitan Railway Company's generating station is situated close to their locomotive and engineering works at Neasden. An abundant supply of water for boiler feed and all other purposes has been found at a depth of over 400 ft., and two artesian wells have been sunk to tap it. The main building of the power station is 327 ft. long by 101 ft. wide, covering an area of 3,570 square yards. This makes it one of the largest stations the world owned by a single railway company.

By the courtesy of the British Westinghouse Company we are enabled to present our readers with a pictorial survey of some of the leading features of interest in connection in with this remarkable plant.



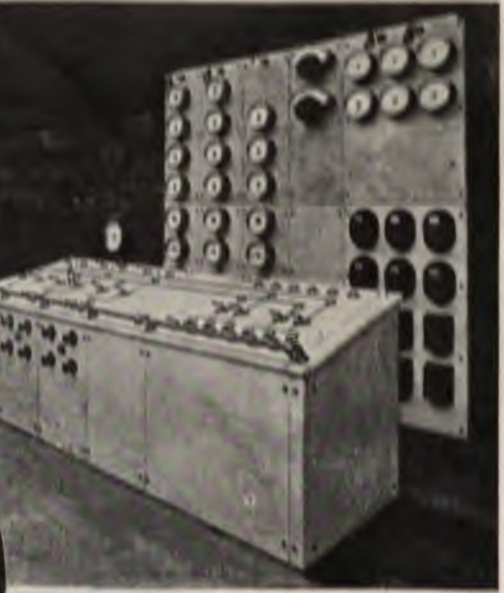
BOILER ROOM.

The main building is divided longitudinally into two parts, the larger of which is the boiler room, measuring 321 ft. long by 53 ft. wide. It contains ten Babcock and Wilcox water-tube boilers, each of 5,730 square feet heating surface, fitted with Babcock superheaters and Roney mechanical stokers, which latter are driven through gearing by Westinghouse vertical enclosed engines. The boilers are each guaranteed to evaporate 20,000 lb. of water per hour, working at a pressure of 180 lb. per square inch and a superheat of 180 deg. F.



ECONOMISER PLANT.

CONDENSERS.



INSTRUMENT AND CONTROL BOARDS.

Two Green's economisers are at present installed, the scrapers being driven by three-phase motors. They have each 1,760 tubes, 10 ft. long and 4 in. in diameter, and are situated in a chamber divided into two parts, each of which is provided with its own engine-driven induced draught fan.

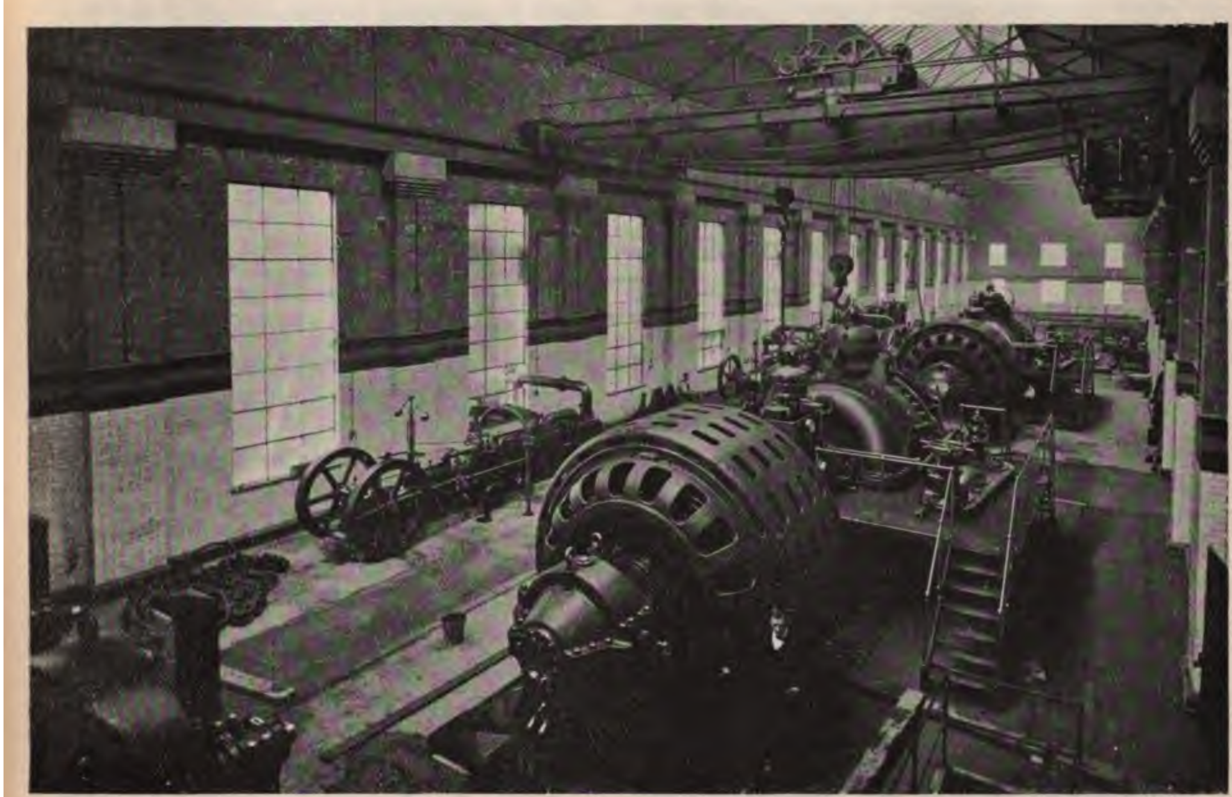
CONDENSING PLANT.

The condensing plant is of the barometric type, and was made by the British Westinghouse Company at their Trafford Park Works, to the designs of the Alberger Condenser Company.

This is a form of condenser that is little known in England, but it was chosen because it is particularly adapted for maintaining the high vacuum at all loads that is such an important feature in the economical working of the steam turbine. Condensers are installed for each main generating unit, and they are separately capable of dealing with 66,500 lb. of steam per hour at normal full load, and 110,000 lb. per hour at maximum overload for a period of one hour. At normal load, a vacuum of 27 in. is attained, and the above overload reduces this only by 1 in. Under the former condition the velocity of the steam at no point exceeds 270 ft. per second, nor the maximum temperature of the circulating water, 85 deg. F.

SWITCHBOARDS.

There are two sets of main 'bus bars, to either of which the generators may be connected by the aid of two switches in series; the one next to the machine, a simple main circuit oil-break-switch, and the other between this and the 'bus bars, the selector-switch for connecting the generator to either set of 'bus bars. In addition, isolating switches are provided and placed, electrically, right on the 'bus bars to allow for safe inspection or repair of the controlling apparatus. By closing both of the selector-switches it is possible to operate with both sets of 'bus bars in parallel.

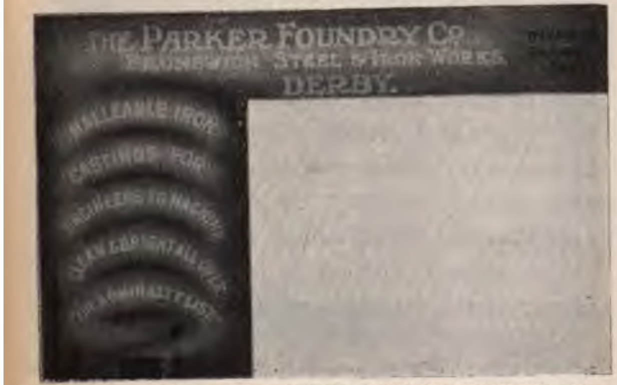


VIEW OF GENERATING PLANT.

The generating plant at present consists of two 5,000-b.h.p. Westinghouse steam turbines, coupled to 3,500-k.w. three-phase Westinghouse alternators, and two more similar sets will shortly be installed. The turbines are of the multiple expansion double-flow type, with a guaranteed steam consumption of not more than 17 lb. at full load, and 9¼ lb. at half load per k.w. hour; steam to be superheated to 180 deg. F., and supplied at a pressure of 180 lb. per square inch. These machines represent the latest practice in every detail, particularly in the reduction in length that has been achieved by an increase in diameter.

The three-phase generators are mounted on a continuation of the turbine bed plate. The output per phase on a non-inductive load is 184 amperes at 11,000 volts, and the guaranteed efficiency is 96·5 per cent. at full load, 95·5 per cent. at three-quarters, and 93·75 per cent. at half load. The speed is 1,000 r.p.m.; and as the rotating field of the alternator has four poles, the frequency is 33⅓ cycles per second. The exciting current is as usual led to the field coils by the aid of slip rings. It is derived from the two exciter units, each of which consists of a Westinghouse single-acting compound engine, running at a speed of 275 r.p.m., direct coupled to a 100-k.w. 125-volt D.C. compound wound generator. One such unit is sufficient to supply all the generators with exciting current at full load. There is an extensive auxiliary plant.

(*To be continued.*)



A POSTCARD ISSUED BY THE PARKER FOUNDRY CO., OF DERBY.

A BUSINESS POSTCARD.

This may be said to be the age of the picture postcard, and the Parker Foundry Company, of Derby, are successfully using the illustrated postcard idea in order to draw attention to their malleable iron castings for engineers, etc. This arrangement is certainly more suggestive and liable to attract attention than a mere display of type. It is highly representative of the type of work carried on, and is suitably rendered in colours.

QUESTIONS OF THE DAY.

The National Encouragement of the British Inventor: How can it be secured? *(Continued from page 76.)*

THIS discussion, which opened in PAGE'S WEEKLY for October 28th, 1904, has called forth some very valuable expressions of opinion by practical men which can scarcely fail to carry considerable weight when the patent question is again before Parliament. In the meantime Mr. Thwaite has prepared a very interesting summary of the views expressed, and as the initiator of the discussion, he has also favoured us with the following general reply to close the correspondence. Says Mr. Thwaite:—

Mr. Balfour, in a reply given last week to a communication from the "London Chamber of Commerce," as to the desirability of reforming some of the clauses of the new Patent Act, does not admit that evidence has been supplied to him, so far to justify any change in the Act.

It is quite certain that Mr. Balfour has not read the opinions expressed in these columns from representative inventors and men associated with them directly and indirectly.

The opinions expressed on some of the objects are so emphatic and unanimous and the arguments urged in support of drastic reform are so irresistible that no member of His Majesty's Government or its Opposition, unless he is conspicuously indifferent to the welfare of his country, can ignore them. I sincerely trust that your enterprise in devoting so much of your valued space to collecting and publishing the various opinions, will culminate in a really practical issue, and will tend in the direction of making the British patent laws the most fostering, and the least costly of any extant.

I will, in brief terms, first refer to the replies of the inventors themselves to the interrogatories you have set out partly under my guidance.

A SUMMARY OF THE VIEWS OF REPRESENTATIVE INVENTORS.

1. The fifty years' period constituting the time range of the search is generally considered to be satisfactory by inventors.*

2. All renewal fees after the fourth year to be abolished. Scale of charges not to exceed those of the American Patent Bureau.

The British Patent Department not to be run at a profit, any surplus over expenditure to be employed:—

(*1st*) To increase the efficiency of the department; and

(*2nd*) To the reduction of patent charges.

3. British patents to be classified and analysed, the work to be supervised by technical experts representing each of the staple industries.

4. The unanimous opinion of British inventors is in favour of the extension of the life of a British patent from 14 to 17 years.

5. Strong personal evidence proves that the effect of the renewal fees is to strangle invention.

6. The general opinion appears to consider the British patent department as unfitted for the work of deciding (first) the value of an invention that has been commercially perfected, and (second) whether the time and money expended has been justified by the results.

The general opinion is also decidedly in favour of the extension of the life of a patent to 17 years, the commercial perfection of which has been costly, both in time and money, but it is considered that the extension of the patent might be limited to 21 years.

---

* I consider that no evidence should be allowed in the Patent Courts anterior to this period of 50 years.—B. H. T.

7. On the question of working or non-working opinion is in favour of the compulsory license clause of the Act.

In the event of a patent being contested, the fact that a patent is not being worked should have weight in the adjudication, that is, unless the patentee can prove that he has done all he possibly could to secure the commercial working of the invention.

8. The opinion is, and almost unanimously, against the proposed system of prize award to inventors.

9. The average opinion is that the life of a patent is to date from day of the actual issue of a patent, and not from date of application.

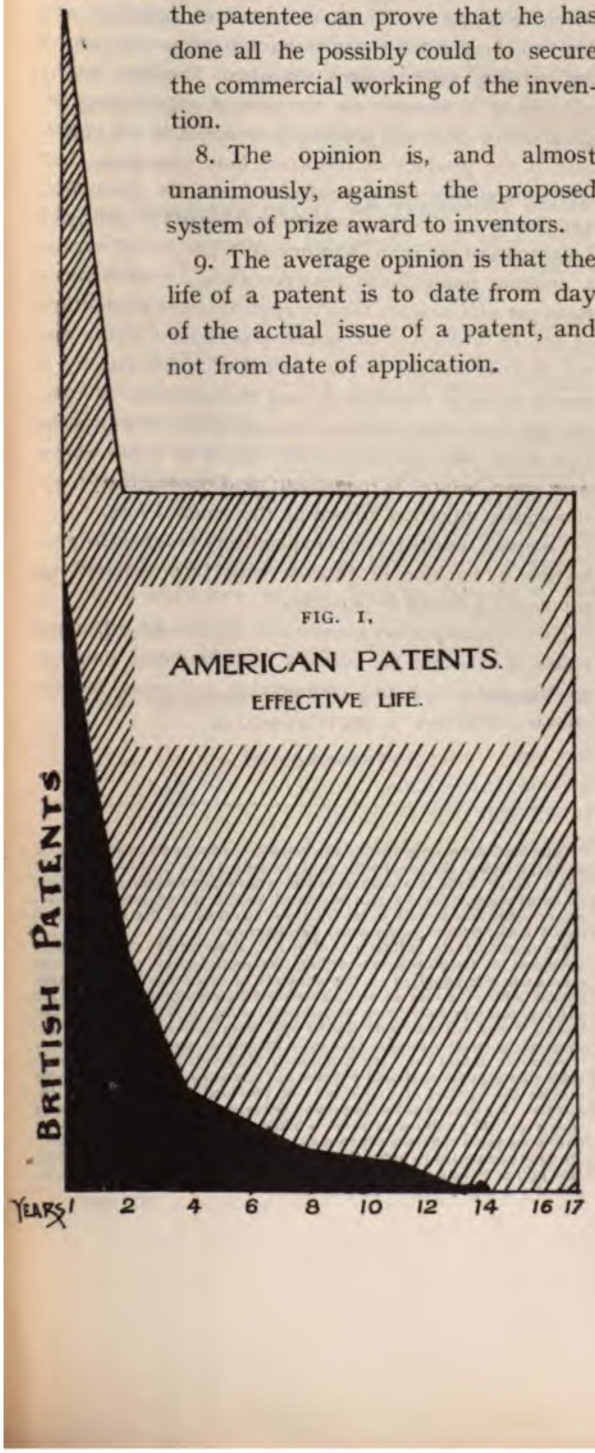


FIG. I.

10. When a foreign country insists on working proof, the inventors of that country shall be compelled to work their British patents in precisely similar terms to those meted out to the British inventor.*

11. On the question of the fixing the royalty rates, opinion is divided; the Patent Department is considered to be unfitted to determine Royalty rates.

12. The adjudication on patent disputes: opinion almost unanimously in favour of the establishment of a tribunal of technical experts assisted by a legal associate.

THE VIEW OF CONSULTING ENGINEERS.

The opinion of the consulting engineers who have participated in the discussion is generally in sympathy with that of the inventors themselves, and especially so on the questions of the duration of the British Patent, and that of compulsory working—17 years' life and reciprocal terms with foreign countries as to compulsory working.

Life of patents involving large expenditure of money and time in commercial perfection to be extended in proportion to such expenditure.†

THE INIQUITOUS RENEWAL FEE TAXATION.

The burning question of the desirability of abolishing or reducing the detestable principle of taxation (embodied in the existing renewal fees) after the fourth year has not, amongst the non-inventor participators in the discussion, received the consideration its importance deserves.

The reproduced graphic diagram (fig. 1) shows conspicuously the deadly effect of the Renewal Fees on the life of British patents. I am bound to say with all deference to those who have extended their distinguished patronage to this discussion, and who admit they have never seen a case of a patent life destroyed by the effect of the renewal fees, that they must be strangely innocent of any actual contact with the struggles of the great body of British inventors.

The correspondence provides overwhelming proof that just as the last straw breaks a camel's back, so does this cruel and ridiculous tax strangle the great bulk of British patents, and if anyone wished to demonstrate the falling back on the rate of progress of this country in the last ten years (and proportionate to its population) he has merely to refer to the existence of the policy of *laissez faire* and indifference, that has permitted a crushing taxation on British invention to exist for so many years to the great and immeasurable loss of the country.

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* I consider that only Foreign Inventors should be permitted to acquire British patents in their own name or through agents as representatives, otherwise this clause in the Act could obviously be easily evaded.—B. H. T.

† Mr. Swinburne urges that no one should apply for a Patent until it is worked out. I am sure Mr. Swinburne, on further consideration, will realise how hardly such a regulation would bear on a poor inventor, who might have the money to protect his invention, but not sufficient to completely work it out, and how is he to do this without risk of someone purloining his unprotected invention.

Puerile in the extreme are the arguments that have been suggested in favour of retaining this repressing influence on inventors. It is suggested that the lapsed patent will permit other inventors to follow in the path of this invention, but no one supporting this argument has brought forward any evidence to prove that an invention based on a patent abandoned by the *force majeur* influences of inadequate finance is likely to prove of value to the inventor, because its basis is admittedly a defunct but published patent.

The one practical suggestion as an alternative to the suppression of the tax is that made by Mr. Thompson the patent expert.

Mr. Thompson suggests that an annual renewal fee of 10s. would amply meet all the requirements and remove all the objections advanced against the repeal of this iniquitous principle of taxation. Probably most inventors would welcome the reduction of the present charges to the nominal value suggested by Mr. Thompson.

SHOULD THE GOVERNMENT MAKE THE PATENT OFFICE A PROFIT-EARNING DEPARTMENT?

The argument raised by one correspondent that there will be no profit surplus to admit of the suppression, or at least the reduction of the renewal fees, is met by the fact that the American patent department secures a substantial but not unreasonable surplus—although this department institutes a search and there are no renewal fees after the patent has been granted. It is admitted that the American patent classification is the finest in existence, so that if the American Government can run its Patent Bureau without incurring a financial loss, and provide a search and grant of a patent life of 17 years for £7, *ceteris paribus*, our Government should be able to do so.

It is almost the unanimous opinion of all the correspondents that the principle of making a profit out of the Patent Office administration for the benefit of the National Exchequer is iniquitous, and damaging to the best interests of the country.

It is quite conceivable that the effect of this correspondence will be to secure for the German inventor happily circumstanced as he is, a reduction of patent taxation to the level of that of the American patent system,. Anyone personally intimate with the two countries, realises the extent of the interchange of ideas of our two formidable rivals, and, if this correspondence in any way tends to the reduction of the German patent fees, it will have justified its existence by benefiting a race of inventors, that can claim *inter alia*, the Siemens family, Dr. Otto, The Krupps, Liebig, Nernst, Welsbach, Hertz Rontgen, and a host of others whose work has benefited the human race directly or indirectly. There should be no dividing geographical or racial division amongst votaries of the creative art. The inventor is *amicus humani generis.* Even our Hiram Maxim's inventive creations will tend to check a too ready recourse to war as the means for settling international disputes. Creative work, whether it produces new mechanical applications or chemical or electrical processes, or works of the beaux arts, is the product of the same kind of genus. Let anyone compare the portraits of Listz, the composer, and George Corliss, the inventor; or those of the late Lord Leighton and Sir John Thorneycroft, and he will notice a striking resemblance between them. Our Government permits creative faculty applied to the production of art or literature to secure proprietary rights for the creative output for the period of a lifetime by a simple form of registration and the payment of 10s., but the man who creates a new machine, or a process that in its effect produces two blades of grass where one grew before, is penalised, and increasingly, by the annual taxation known as the renewal fees.

Compare, moreover, the expenditure involved in perfecting a machine or process with that required in producing a design or painting.

No! The iniquitous taxation of the inventor has no *raison d'etre*, and has already done immense damage to the industrial and commercial well-being of the country.*

(*To be continued.*)

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*The implacable opponent of the inventor—admittedly often poor in pocket, if rich in the peculiarity of his inventive faculties—would make him a source of the maximum possible taxation, and would thus secure his suppression. The inventor of limited wealth would rarely, if ever, secure—either for himself or his friends—the return of the expenditure risked in the work of commercial development,

Fortunately, if the indifference of British statesmen to the enormous influence of invention—remodelling the destinies of nations—has resulted in the adoption of the principle of disastrous taxation, embodied in the renewal fees, and a short and discouraging life, the people at large, and especially those who have travelled in Germany and the United States, are becoming day by day more and more alive to the value of the creative products of their inventive countrymen.

No doubt in time the new Examining Staff will acquire the knowledge that experience should provide, but any practical experience can provide the equipment that should be provided by a competent examiner. My friends of the Improved German Patent Office are men who have held positions of responsibility in manufacturing work, or have done important services to some one or other industry, and they are fully competent to judge the pros and cons of an innovation which may appear to be a mere detail, but which is nevertheless the missing link of a change of important processes.

THE EFFECT OF THE ABANDONED PATENTS (PRINCIPALLY THROUGH THE, MALIGN INFLUENCE OF THE RENEWAL FEE TAXATION) ON FUTURE INVENTIVE EFFORT.

Correspondents have evaded the question of the deadly effect of the cemetery of tax-killed patents upon the vitality of inventive energy, raised in my opening letter, and there is no alternative remedy to that of resuscitation.

Had these mostly-renewal tax-killed patents had the life given to a patent by the American Government—or seventeen years—scores of combinations of different inventors would have been made, because in nine cases out of ten, an inventor would adopt the policy of combination rather than that of the dog in the manger, which in its effect is often equivalent to the mad policy of cutting off one's nose to spite one's face.

THE PROPOSED COURT OF TECHNICAL EXPERTS.

On the question of the constitution of a Court of Technical Experts, the opinion as far as it is clear and definite is in favour of the German model.

There should be no difficulty in establishing courts of technical experts in the great branches of British Institutions, even if you have to import German or American experts.

The somewhat vulgar phrase of the *vox populi* that the British law is an ass, is accepted too seriously not to have some justifiable basis for its existence, and just as technical and business questions of immense importance are daily settled without recourse to legal assistance, so can disputes relating to inventions be settled by the Courts of Experts, which may have the assistance of legal assessors.

THE QUESTION OF THE LIFE PERIOD TO BE ALLOWED FOR A PATENT.

The eloquently expressed arguments advanced by Mr. Heath in his highly philosophic contribution to support his bold contention, that the life of an important patent should be perpetual, are academically irresistible, but of course the proposition might be employed to the detriment of inventors. No! An inventor should have time allowance to realise the value of his inventions—and in this connection I appreciate the suggestion advanced by Mr. Swinburne that small inventions, or inventions relating to articles that can be made suitable for the market in a few months, on the expenditure of a few pounds, should be satisfied with a smaller patent life monopoly, than the inventor who patents an invention, the commercial perfection of which requires years of time and thousands of pounds.

THE COMPETENCY OF THE NEW CORPS OF EXAMINERS.

There has never been any desire to reflect on the competency of the Patent Office staff to carry out the provisions of the old Act. The only question raised is the competency of the Searching and Examining Corps appointed to differentiate between new and old inventions.

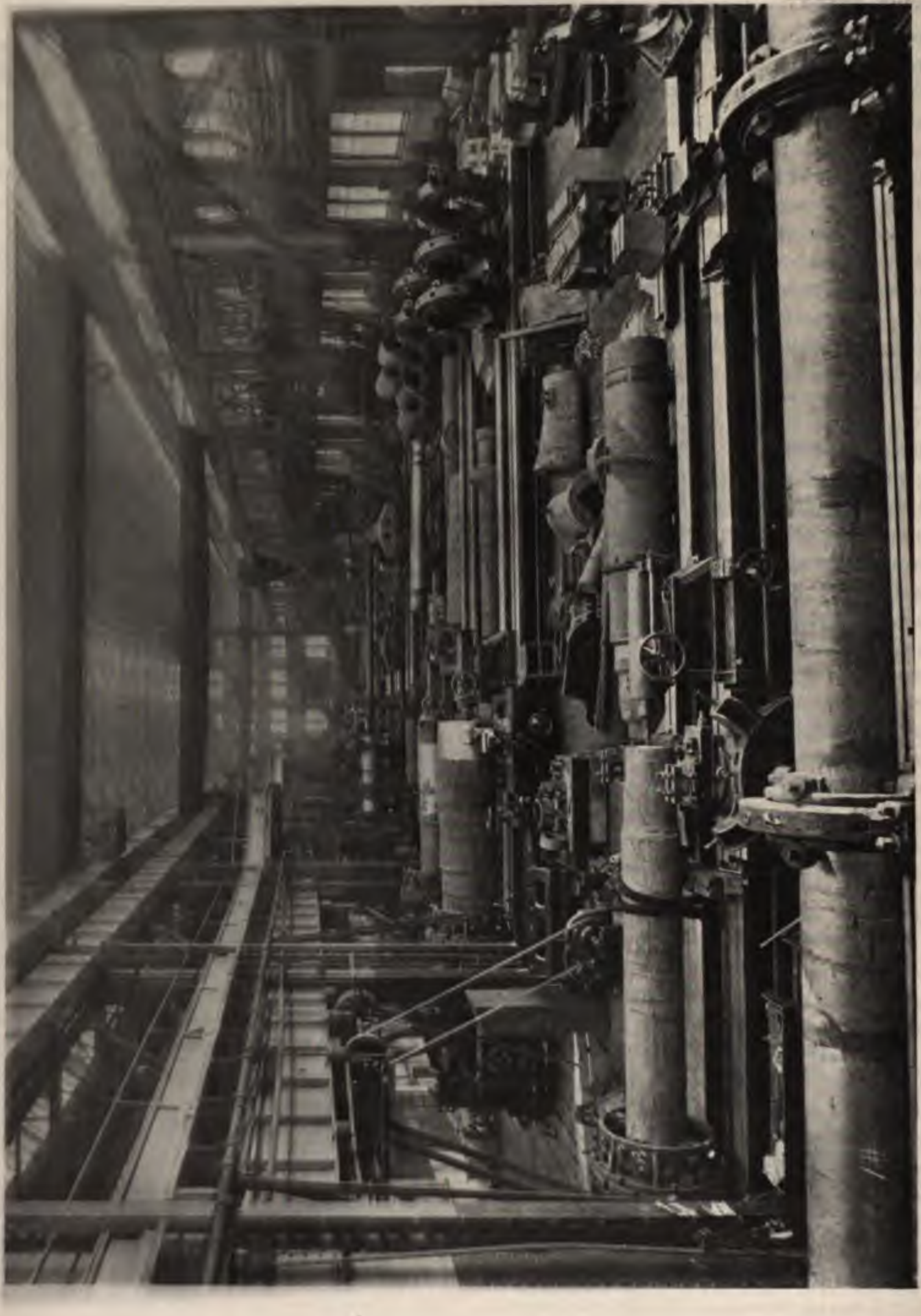
Anyone who is fully cognisant of the complexity of most of our modern manufacturing industrial processes, and who adequately appreciates how often the success of a new process is secured by an apparently trivial, but what is, in reality, an all important detail and one constituting the pith and marrow of an invention, will be justified in his distrust of the opinion, upon the subtle value of a detail, of a member of a staff that is innocent as a newborn babe of a practical knowledge of the manufacturing process to which the invention belongs.

(*To be continued.*)

CLEVELAND INSTITUTION OF ENGINEERS.

At the meeting of this Institution, held on the 16th inst., Mr. J. H. Harrison, M.Inst.C.E., read an interesting paper on the subject of "Foreign Competition in the Manufacture of Iron and Steel."

The conclusion at which the author arrives is that while a good deal is being done to meet foreign competition, there is still ample room for reform in English methods of manufacture and management. He does not advocate the slavish imitation of American methods, holding that there is a middle course between American practice and our own, which, if properly applied, would give record profits. The greatest barrier to progress in this country is the conservatism of the iron and steel trade. The inventive power for objections to any new idea, especially if not imported, is enormous. A great deal can be done in the way of producing more cheaply without sacrificing quality. The secret of success is first in having the best plant, and then in arranging that plant so as to make the process of manufacture continuous from the raw material to the finished product, with the least possible waste of time, and with the least possible handling. Extracts from Mr. Harrison's paper will appear in the next issue of PAGE'S WEEKLY.



ORDNANCE MACHINE SHOP—THE MIDVALE STEEL COMPANY.

A GROUP OF FORGED STEEL SHOT AND SHELL, ARMOUR PIERCING AND COMMON. 57 M.M. TO 13 IN. 6 LB. TO 1,100 LB. BY THE MIDVALE STEEL COMPANY.

STEEL FOR THE MANUFACTURE OF ARTILLERY.

BY COLONEL CUBILLO (SPANISH ROYAL ARTILLERY).

III.

(*Continued from page* 75.)

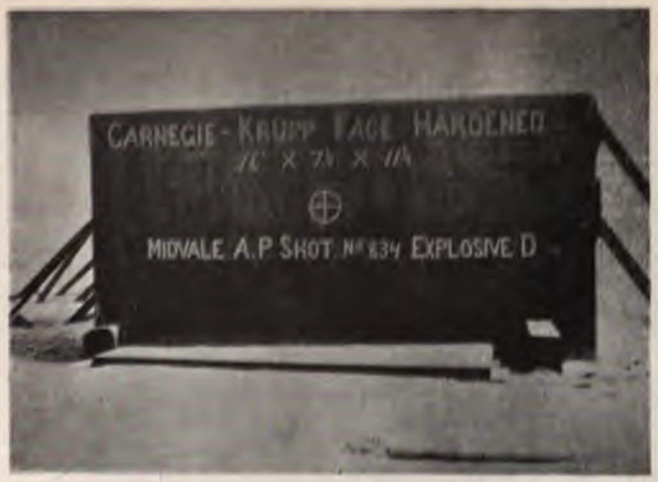
WE will now turn to an important experiment with cannon metal effected in the Watertown Park. The Watervliet Works had observed that, as much in solid forged tubes as in hollow forged sleeves, there existed certain shades or stains of a dark colour, narrow in proportion to their length, and running in a line with the axis of the piece. These stains were discovered when smoothing the tubes and sleeves in the lathe, according to the class of tool used in this operation they appeared more or less in relief. A file darkened them; a half cut of the tool made them jut out; if a large shaving was made they were hidden. These are observations of American officials; we have had more than one occasion to notice these stains at Trubia; no gun of 15 centimetres is stained in this manner.

It is not easy to point to the cause of these shades; perhaps we may attribute them to the cavities or bubbles formed at the moment of the solidification of the steel. This, however, is a mere hypothesis, the true cause is unknown. The traction characteristics of a metal free from stains, and those of having them in abundance are as follows, and not unfavourable to the latter metal :—

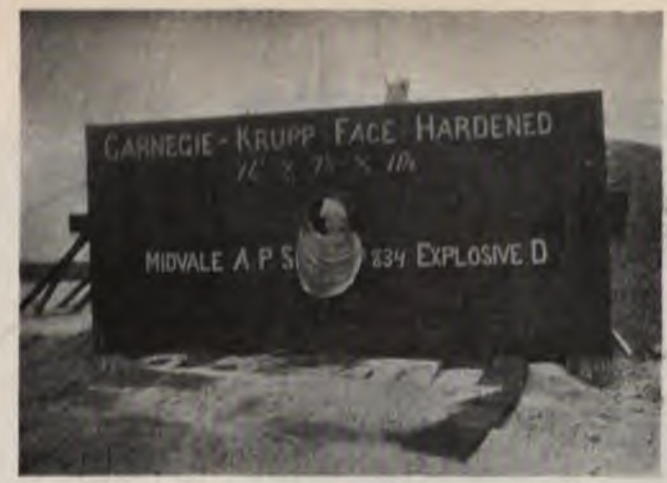
Metal with Stains.	Elastric Limit. Kg. x mm.^{2}	Fracturing Load. Kg. x mm.^{2}	Enlargement. %	Contraction. %
Average results ...	38	73·2	17·1	42·7
Maximum	39	75·3	19·2	47·1
Minimum	37	71·1	15–	38·3
Metal without Stains.				
Average	39·7	77·9	12·8	36–
Maximum	40·4	78·3	13·7	36·9
Minimum	39·0	76·0	12·0	35·2

As seen from this table we cannot say that one metal is inferior to the other; that free from stains or lines possesses greater tenacity, whereas the other has greater ductility; perhaps we might almost say that the metal free from stains is the inferior.

The chief of the Artillery Technical Department ordered the Watertown Arsenal to

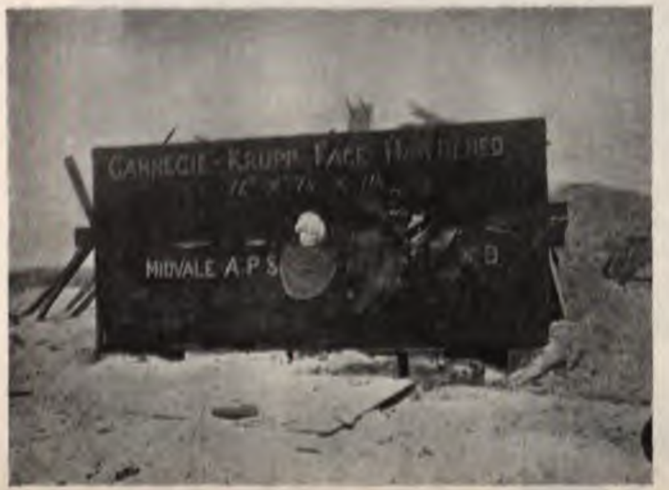

CARNEGIE - KRUPP FACE HARDENED
MIDVALE A.P SHOT No 834 EXPLOSIVE D

12-IN. ARMY SERVICE RIFLE TARGET—BEFORE FIRING.



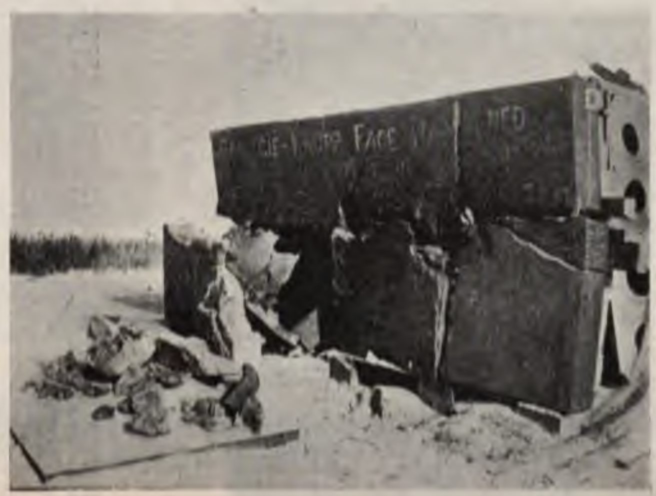
12-IN. ARMY SERVICE RIFLE TARGET—FIRST ROUND.

Midvale Armour-Piercing Shot, 1,001 lb. 7 oz. ; 1,800 ft. per second velocity ; 4,400 yds. range ; 22,500 ft. tons striking energy.



12-IN. ARMY SERVICE RIFLE TARGET—SECOND ROUND.

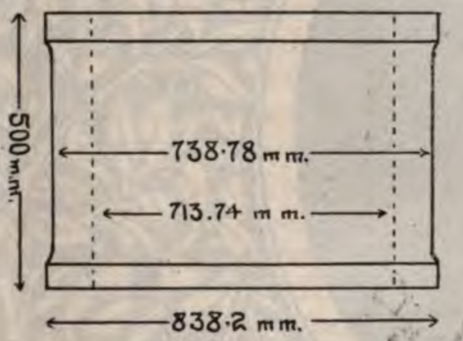
Midvale Armour-Piercing Shot, 1,006 lb. ; 1,804 ft. per second velocity ; 4,400 yds. range ; 22,500 ft. tons striking energy.



12-IN. ARMY SERVICE RIFLE TARGET—THIRD ROUND.

Midvale Armour-Piercing Shot, 1,045 lb. ; 2,073 ft. per second velocity ; 1,880 yds. range ; 31,100 ft. tons striking energy.

experiment with both classes of metal, submitting a hoop of each to hydrostatic pressures which should not exceed the tangential-elastic resistance of the steel, repeating the operation a certain number of times, and afterwards increasing the pressure until the hoops fractured. The dimensions of the hoops are shown below :—



It is not necessary to say what means were adopted to exert the pressure required. After noting the tangential elastic resistance of the hoops, their dimensions and traction characteristics, they were submitted to pressures of 150 to 200 kilogrammes per square centimetre less than those employed for elasticity. This pressure was repeated 500 times on each hoop and was then increased until they fractured. Neither hoop showed any appreciable permanent deformation from the 500 pressures, but after passing the elastic limit the difference between the two metals was very marked. In the shaded metal three small stains or lines opened perceptibly under a pressure of 4,100 kilogrammes, and at 4,600 kilogrammes one of the three openings increased in size. The metal of the other hoop bore the strain up to the fracturing limit admirably. The stained metal hoop broke under a pressure of 6,350 kilogrammes per square centimetre. The elastic limit of the two coincides with the minimum value found in the traction tests. In breaking, the stained metal gave less resistance than that shown in the test and was very deficient in elongation, the hydrostatic test giving only 4 per cent., whereas 18 per cent. was shown by the traction test. On the contrary, the clear metal showed greater resistance and elongation. The results of these experiments are very interesting; they indicate, first, that the traction tests alone are not sufficient to give an idea of the quality of a metal, and that defects of much importance on passing the elastic limit do not exist between that period of the resistance not passed by the fire tests. It is clear that the officials who conducted these experiments did not apply a slowly increasing pressure until fracture occurred, but repeated the elastic pressure 500 times, because, without doubt, this would be the number of rounds fired from a big-calibre gun, and if any guns in use had been constructed of sleeves and hoops of stained metal, they would have been convinced that these guns were in no danger of bursting.

In the writer's opinion, the tests within the elastic limit, such as made by the American Commission, may be likened to the shooting tests, because, if in these tests the pressure reaches its maximum in a very short time, it is also certain that it quickly disappears. In the hydrostatics proof, the increase of the pressure is slow; but the time occupied is always much longer than that taken by the rounds in the body of the gun.

THE FUTURE OF THE PEDRAIL.

A practical demonstration of the capabilities of Mr. Diplock's pedrail tractor, was recently made in the clearing-yard of the Prince's Dock, Liverpool. The demonstration was of an exhaustive nature, and was followed with great interest. Mr. Diplock mentioned that the present machine had an average speed of four or five miles an hour, and that he was at present designing one to average eight. He saw no difficulty whatever in making certain adjustments which would render feasible a speed of fifteen or twenty miles an hour. Next month, at the request of the War Office, an attempt will be made to show what the machine is capable of doing in the way of hauling heavy weights over soft ground by pulling a big gun up the Long Valley at Aldershot.

Photo by Elliott and Fry.]

OUR WEEKLY BIOGRAPHY.

Professor ALFRED KIRBY HUNTINGTON, A.R.S.M., F.I.C., M.I.M.M.

PROFESSOR A. K. HUNTINGTON, Chief of the Metallurgical Department, King's College, was born in Norfolk, in 1856. His father was the third son of John Barker Huntington, of Somerton Hall, his mother a daughter of Henry d'Esterre Hemsworth, D.L., of Shropham Hall.

He went through what he considers the usual indifferent secondary education of English schools, and then stayed with relations in France for about two years, attending College and receiving private tuition. Returning to England he worked for a short period in the Secretary's Office of the General Post Office at about the time when the Government assumed control of the telegraphic systems of the country. Deciding to take up a scientific career, he joined the Royal School of Mines in 1874, going out in 1877 with the Associateship in both Mining and Metallurgy.

He next collaborated with Dr. Guthrie in his well-known work on Cryohydrates which led up to the far-reaching discovery of "eutectics" in metallic alloys, and the recent greater progress in Metallography; was associated with Professor W. N. Hartley in his fruitful researches on "Absorption Spectra of Ultra-Violet Rays," and with Dr. Percy in laboratory investigations for the second volume of his Metallurgy of Gold and Silver, which, however, was never published, the work eventually being incorporated in the German edition of the first volume. In 1879 Professor Huntington was elected to fill the Chair of Metallurgy at King's College, London, since when he has been continuously occupied in investigations having practical applications in Marine and Railway Engineering. He was one of the first to experiment with an electric furnace, the late Sir William Siemens having placed at his disposal the electric furnace shown at the Smoke Abatement Exhibition. It was afterwards transferred to Professor Huntington's laboratory, where it was worked by five D2 dynamos, driven by a 12 h.p. Marshall's portable engine. The light given by the arc was computed at the time at 200,000 candle power.

In 1882, conjointly with Sir William Siemens, Professor Huntington, read before the Southampton Meeting of the British Association a paper on some of the results of the experiments in the electric furnace. This was the first occasion on which tungsten had been shown in any other condition than that of powder. With its high fusing point and a volatilisation point near that at which the metal fuses, a powder being a bad conductor of heat, it is extremely difficult to obtain tunsgten in a solid condition. Whilst experimenting with this furnace, iron and carbon were fused in time and the production of carbide and from it acetylene were noted, but no attempt was made to develop this fact commercially.

About this time, Professor Huntington gave a course of six lectures in Birmingham to those interested in the brass industries. These were attended by from 800 to 1,000 students each night. A year later he was requested to give a course on iron and steel, but being of opinion that this was not the most advantageous way to deal with education, he induced those concerned to equip a laboratory at the Midland Institute. which proved to be the precursor of many laboratories in different parts of the country. In 1892 he was instrumental with others in forming the Institution of Mining and Metallurgy, and in 1894 was elected President. Professor Huntington's contributions to the technical press include a text-book on "Metals," and a number of papers to be found in the transactions of various scientific societies. He is an enthusiastic aeronaut and motorist, and in the last-named connection he is experimenting with an automatic change-speed gear which shows fair promise of practical success.

THE LODGE FOG-DISPERSAL APPARATUS.

We shall look forward with interest to hearing more about the business side of this apparatus (referred to on page 113), which will probably be on view shortly in London. If the cost of the remedy be excessive, we have on the other side of the ledger, an enormous waste of money, time, and health, the extent of which it is difficult to estimate. Figures recently published by the Railway News to take a single department of industrial activity showed that for one half-year the pervalence of fogs added £9,344 to the traffic expenses of the London and North-Western Railway. A dense fog on the North London system renders it necessary to have 200 fogmen at work, and the fog practically costs the company £7 an hour during its continuance. The fog cost the Great Western £3,200, and the Great Eastern an extra £5,000 in the second half of 1901, and the unusual prevalence of fogs in October and November of that year caused an additional outlay in wages alone in the traffic department of the London and South-Western Railway of £3,200, and a large increase in overtime to the staff generally.

STANDARD SPECIFICATION FOR PORTLAND CEMENT.

THE specification just issued by the Engineering Standards Committee on Portland Cement, provides that the cement shall be prepared by intimately mixing together calcareous and argillaceous materials, burning them at a clinkering temperature and grinding the resulting clinker. No addition of any material is to be made after burning, except when desired by the manufacturer and if not prohibited in writing by the consumer, in which case calcium sulphate or water may be used. The cement, if watered, must contain not more than 2 per cent. of water, whether that water has been added or has been naturally absorbed from the air. If calcium sulphate is used, not more than 2 per cent., calculated as anhydrous calcium sulphate, of the weight of the cement is to be added.

The cement is to be ground to comply with the following degrees of fineness, viz. :—

The residue on a sieve 76 by 76 = 5,776 meshes per square inch, shall not exceed 3 per cent.

The residue on a sieve 180 by 180 = 32,400 meshes per square inch shall not exceed 22½ per cent.

The sieves are to be prepared from standard wire, and the size of the wire for the 5,776 mesh shall be ·0044 inch, and for the 32,400 mesh, ·002 inch. The wire must be woven (not twilled), the cloth being carefully mounted on the frames without distortion.

DIMENSIONS OF BRIQUETTE.

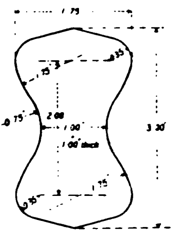


Fig A

DETAILS OF JAWS FOR HOLDING BRIQUETTE.

PLAN

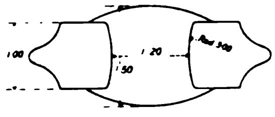
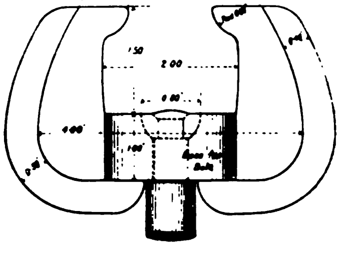


Fig B.

ELEVATION.



The specific gravity of the cement is to be not less than 3·15, when sampled and hermetically sealed at the manufacturer's works, nor less than 3·10 if sampled after delivery to the consumer.

The cement must comply with the following condition as to its chemical composition. There shall be no excess of lime, that is to say, the proportion of lime shall not be greater than is necessary to saturate the silica and alumina present.* The percentage of insoluble residue shall not exceed 1·5 per cent. ; that of magnesia shall not exceed 3 per cent. ; and that of sulphuric anhydride shall not exceed 2·5 per cent.

The cement after being gauged, is to be filled, without mechanical ramming, into moulds of the form shown in fig. A, plate I, each mould resting upon an iron plate until the cement has set.

Briquettes of neat cement of the shape shown in fig. A, are to be gauged for breakiug at 7 and 28 days respectively, six briquettes for each period. The average tensile strength of the six briquettes shall be taken as the accepted tensile strength for each period. For breaking the briquette must be held in strong metal jaws, of the shape shown in fig. B., the briquettes being slightly greased where gripped by the jaws. The load must then be steadily and uniformly applied, starting from zero, increasing at the rate of 100 lb. in 12 seconds. The briquettes are to bear on the average not less than the following tensile stresses before breaking :—

7 days from gauging, 400 lb. per square inch of section. 28 days from gauging, 500 lb. per square inch of section. The increase from 7 to 28 days shall not be less than :—

25% when the 7 day test falls between 400 lb. to 450 lb. per square inch of section ; 20% when the 7 day test falls between 450 lb. to 500 lb. per square inch of section ; 15% when the 7 day test falls between 500 lb. to 550 lb. per square inch of section ; 10% when the 7 day test is 550 lb. per square inch or upwards.

Details follow as to the prescribed sand test, setting time, soundness, and acceptance, for which we must refer readers to the original specification.†

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* The proportion of lime to silica and alumina shall be not greater than the ratio represented by $\frac{\mathrm{CaO}}{\mathrm{SiO_2+Al_2O}}=2\cdot75$.

† Published by Crosby Lockwood and Son. It may be obtained through any bookseller, or direct from the offices of the Committee at 28, Victoria Street, Westminster, S.W.

IMPROVED MOTOR-DRIVEN HEXAGON TURRET LATHE.

BY MESSRS. ALFRED HERBERT, LTD., COVENTRY.

THE illustration on page 134, shows the latest development of the Patent Hexagon Turret Lathe built by Messrs. Alfred Herbert, Ltd., Coventry. The machine as shown is driven by a direct-connected electric motor which has a moderate range of speed variation, a large proportion of the speed changes being obtained mechanically by means of friction clutches in the lathe headstock.

It is found that the use of motors having a large speed variation causes trouble owing to the reduced power of the motor at low speeds, and it is for this reason that a motor having a comparatively small speed variation, obtained by inserting resistance into the field circuit, is used. By this arrangement the motor gives its maximum power at the slow end of the speed range, the lighter efforts being reserved for the small diameters and the smaller cuts. The motor is of the direct-current type driving the headstock by means of spur-gearing, and is compactly arranged. The switches and controller are mounted on a stand seen at the left-hand side of the machine, this being a convenient position for the operator. This type of machine has been designed principally for producing articles such as screws, studs, spindles, etc., direct from the bar without forging. In cases where forgings must be employed, as on valve rods with forked ends, these can be easily handled by removing the automatic chuck and substituting a three or four-jaw chuck. Owing to the form of the turret, which is hollow, allowing the work to pass right through it, both long and short work is handled, and, as the patent turning-tool-holders are very readily adjusted for diameter, it has been found quite economical to produce even one or two pieces at a setting, the lathe being extensively used in jobbing and repair work.

The leading principle of the machine is that it finishes each diameter from the rough bar at one cut, no finishing cut being required, and the design has just been modified so as to take full advantage of the recent improvements in high-speed cutting tools.

The bar is gripped by an automatic chuck, operated by the vertical lever at the front of the headstock. The chuck may be opened and closed without stopping the machine. The end of the bar is steadied by means of a 3-jaw self-centring chuck, which is operated by the handwheel at the rear end of the spindle. The automatic chuck is provided with a full set of jaws for gripping round, square or hexagon bars up to the full spindle capacity, the jaws not in use being carried in a swinging tray conveniently attached to the cabinet leg. This tray also carries the screwing dies and cutting tools.

The hexagon turret is mounted on a saddle having a long bearing on the bed. This saddle is provided with an automatic feed having three changes, all obtainable by moving the vertical lever seen on the front of the gear box. The feed may be reversed by throwing over the small horizontal lever immediately above the feed change lever. The feed is instantly changed or reversed, without stopping the machine. The automatic stops to the travel of the turret are carried on the hexagon bar in the front of the machine. There are six stops, one to each

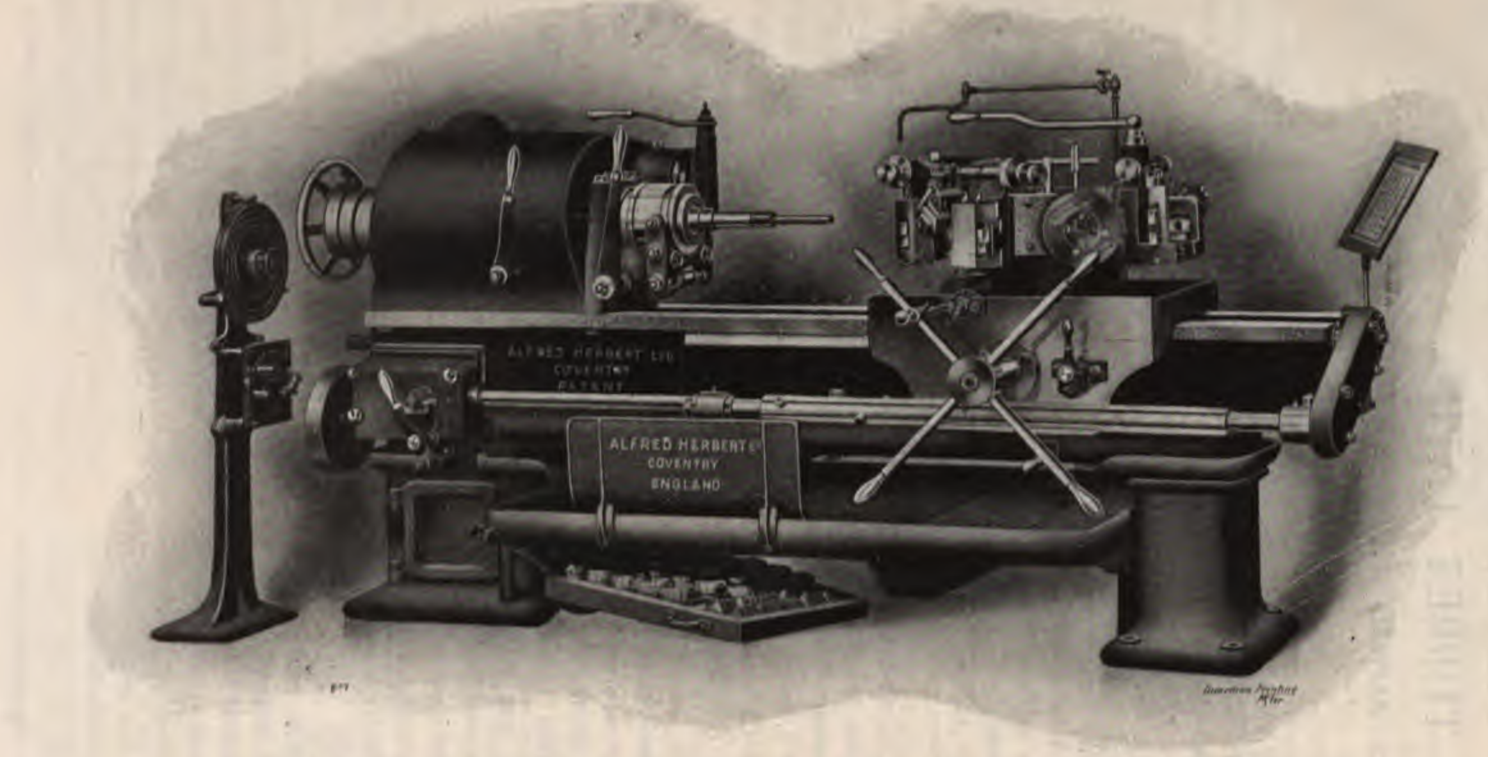

FIG. I. IMPROVED MOTOR-DRIVEN HEXAGON TURRET-LATHE BY MESSRS. ALFRED HERBERT, LTD., COVENTRY.

face of the turret. The hexagon bar revolves in unison with the turret, thus bringing that stop into action which relates to the particular tool which is working; consequently any tool can be adjusted to turn any given length without interfering with the others. The feed is tripped by means of a dropping worm.

The turning toolholders are one of the most important features of this machine. They are capable of dealing with any required reduction in diameter at one cut, and are so arranged that the same toolholder can be used for cutting either towards or away from chuck, the change being made by simply substituting a left hand cutter, using the same toolholder and steadies. On long work it is necessary in order to produce a true running job to commence close up to the chuck and to feed away from the head-stock, thus keeping the job in tension. The illustration (fig. 2) shows the turning tool-holder very clearly. After the tool has been clamped down all adjustments of tools

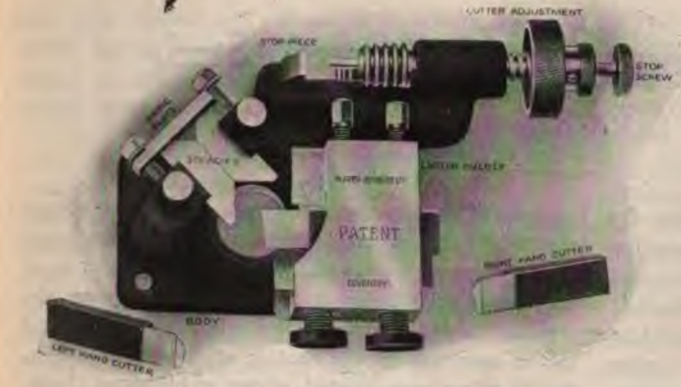

FIG. 2. TURNING TOOL-HOLDER.

and steadies are made entirely with the fingers and without the need of screw-drivers or spanners Screwing is done by means of the "Coventry" self-opening diehead, which is arranged to open automatically at any desired point, and is also fitted with a roughing and finishing attachment by which means a finishing cut may be taken when screwing large threads on difficult material.

Although these machines have been largely used for ordinary bar work, such as shafts, bolts, pins, studs, bushes, etc., there are yet a number of jobs which might appear to be unsuited for the lathe, but on which we are assured that great economies can be effected. Work such as piston rods, air-pump rods, armature spindles, which have a long plain portion in the centre, are frequently made on these machines from bright drawn steel bars which are not machined at all on the plain central portion, but are subsequently finished on this part by grinding, if a fine finish is required. One end is first machined, the work is then reversed, the part machined at the first operation, being supported in a bush fitted in the spindle so as to hold it true, and the second end is then finished. Work of this kind can also be centred in the lathe for the subsequent operation of grinding.

Work, such as boiler stays, having two threaded portions separated by an unthreaded portion can be produced by a special arrangement of diehead and guide nut so that the pitch of the two threaded portions may be continuous so as to suit the error of the stay tap. For repetition work having a number of diameters, box tools are furnished enabling all the diameters to be turned at the same time.

For taper work a special taper-turning tool is fitted with an adjustable taper bar, which can be set to any desired angle. For work having curved outlines, broad form tools are used; examples of such work will be found in the pilot handles on lathe itself.

No. 2 machine admits bars up to 2 in. diameter, working stroke of turret 30 in., maximum size of Whitworth thread cut with self-opening diehead 1¼ in., or 2 in. with special diehead.

No. 3 machine admits bars up to 2½ in. diameter, working stroke of turret 36 in., maximum diameter of Whitworth thread cut with self-opening diehead 2 in.

No. 5 machine admits bars up to 4½ in. diameter, working stroke of turret 42 in., maximum size of Whitworth thread cut with self-opening diehead 3 in., or 4½ in. with special diehead.

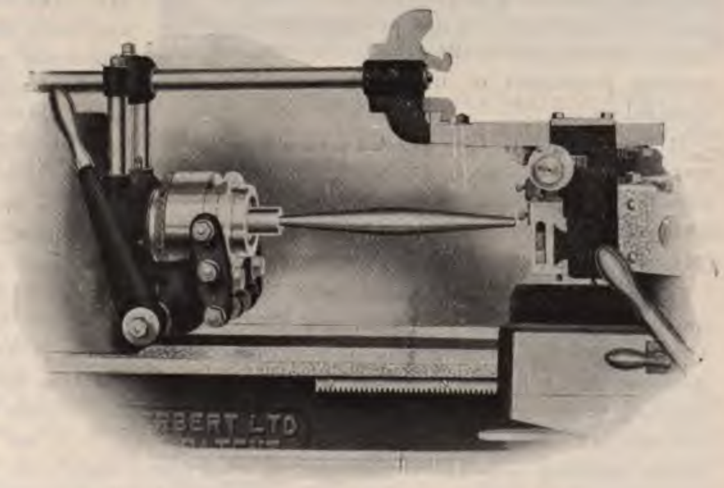

FIG. 3. SPECIAL TAPER-TURNING TOOL.

The Heat Treatment of High-Speed Steel.

BY J. M. GLEDHILL.

THE high-speed steels of the present day are combinations of iron and carbon with (1) tungsten and chromium, (2) molybdenum and chromium, and (3) tungsten, molybdenum and chromium. In the heat treatment of high-speed steel, one of the most important points is the process of thoroughly annealing it after working into bars. Accurate annealing is of much value in bringing the steel into a state of molecular uniformity, thereby removing internal strains that may have arisen, due to casting and tilting, and at the same time annealing renders the steel sufficiently soft to enable it to be machined into any desired form for turning tools, milling cutters, drills, taps, screwing dies, etc.

The annealing of high-speed steel is best carried out in muffle furnaces (see fig. 2), designed for heating by radiation only, a temperature of 1,400 deg. F., being maintained from twelve to eighteen hours according to the section of the bars of steel dealt with.

Further advantage also results from careful annealing by minimising risks of cracking when the steel has to be reheated for hardening. In cases of intricately-shaped milling tools having sharp square bottom recesses, fine edges, or delicate projections, and on which unequal expansion and contraction are liable to operate suddenly, annealing has a very beneficial effect towards reducing cracking to a minimum.

Increased ductility is also imported by annealing, and this is especially requisite in tools that have to encounter sudden shocks due to intermittent cutting, such as planing and slotting tools, or others suddenly meeting projections or irregularities on the work operated on.

It may be noted that the ductility of annealed specimens is very good, rendering the steel in a condition to withstand the great pressures due to the forces thrown upon it when cutting.

PREPARATION OF HIGH-SPEED STEEL.

In preparing high-speed steel ready for use the process may be divided principally into three stages: forging, hardening, and grinding. It is, of course, very desirable that high-speed steel should be capable of attaining its maximum efficiency and yet only require treatment of the simplest kind, so that an ordinarily skilled workman may easily deal with it, otherwise the preparation of tools becomes an expensive and costly matter, and materially reduces the advantages resulting from its use. Fortunately, the treatment of the rapid steel produced by the author's firm is of the simplest; simpler in fact than ordinary carbon steels or the old self-hardening steels, as great care had to be exercised in the heating of the latter steels, for if either were heated above a blood-red heat, say 1,600 deg. F. the danger of impairing their efficiency by burning was considerable; whereas with the high-speed steel, heating may be carried to a much higher temperature, even up to melting point, it being practically impossible to injure it by burning. The steel may be raised to a yellow heat for forging, say 1,850 deg. F., at which temperature it is soft and easily worked into any desired form, the forging proceeding until the temperature lowers to a good red heat, say 1,500 deg. F., when work on it should cease and the steel be reheated.

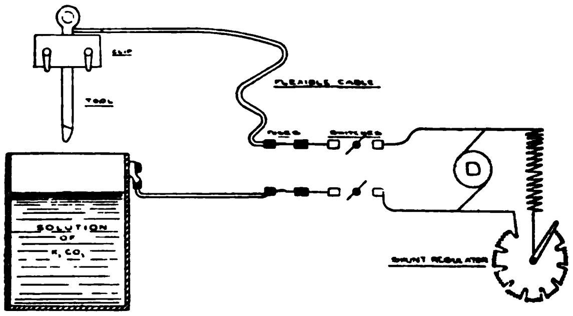

FIG. I. APPARATUS FOR ELECTRICALLY HEATING THE POINTS OF TOOLS.

In heating a bar of high-speed steel preparatory to forging (which heating is best done in a clear coke fire) it is essential that the bar be heated thoroughly and uniformly, so as to ensure that the heat has penetrated to the centre of the bar, for if the bar be not uniformly heated, leaving the centre comparatively cold and stiff, whilst the outside is hot, the steel will not draw or spread out equally, and cracking will probably result. A wise rule in heating is to "hasten slowly."

It is not advisable to break pieces from the bar whilst cold, the effect of so doing tending to induce fine end cracks to develop which ultimately may extend and give trouble, but the pieces should be cut off whilst the bar is hot, then be reheated as before and forged to the shape required, after which the tool should be laid in a dry place until cold.

TEMPERATURE FOR HARDENING.

The temperature for hardening high-speed steel varies somewhat according to the class of tool being dealt with.

When hardening turning, planing or slotting tools, and others of similar class, the point or nose of tool only should be gradually raised to a white melting heat, though not necessarily melted, but even should the point of the tool become to a more or less extent fused or melted no harm is done. The tool should then be immediately placed in an air blast and cooled down, after which it only requires grinding and is then ready for use.

Another method which may be described of preparing the tools is as follows :—

Forge the tools as before, and when quite cold grind to shape on a dry stone or dry emery wheel, an operation which may be done with the tool fixed in a rest and fed against the stone or emery wheel by a screw, no harm resulting from any heat developed at this stage. The tool then requires heating to a white heat, but just short of melting, and afterwards completely cooling in the air blast. This method of first roughly grinding to shape also lends itself to cooling the tools in oil, which is specially efficient where the retention of a sharp edge is a desideratum, as in finishing tools, capstan, and automatic lathe tools, brass-workers' tools, etc.

In hardening where oil cooling is used the tools should be first raised to a white heat, but without melting, and then cooled down either by air blast or in the open to a bright red heat, say 1,700 deg. F., when they should be instantly plunged into a bath of rape or whale oil, or a mixture of both.

Referring to the question of grinding tools, nothing has yet been found so good for high-speed steels as the wet sandstone, and the tools ground thereon by hand pressure, but where it is desired to use emery wheels it is better to roughly grind the tools to shape on a dry emery wheel or dry stone before hardening. By so doing the tools require but little grinding after hardening, and only slight frictional heating occurs, but not sufficient to draw the temper in any way, and thus their cutting efficiency is not impaired. When the tools are ground on a wet emery wheel and undue pressure is applied, the heat generated by the great friction between the tool and the emery wheel causes the steel to become hot, and water playing on the steel whilst in this heated condition tends to produce cracking.

With regard to the hardening and tempering of specially formed tools of high-speed steel, such as milling and gear cutters, twist drills, taps, screwing dies, reamers, and other tools that do not permit of being ground to shape after hardening, and where any melting or fusing of the cutting edges must be prevented, the method of hardening is as follows :—

A specially arranged muffle furnace (fig. 2) heated by gas or oil is employed, and consists of two chambers lined with fire-clay, the gas and air entering through a series of burners at the back of the furnace, and so under control that a temperature up to 2,200 deg. F. may be steadily maintained in the lower chamber, whilst the upper chamber is kept at a much lower temperature.

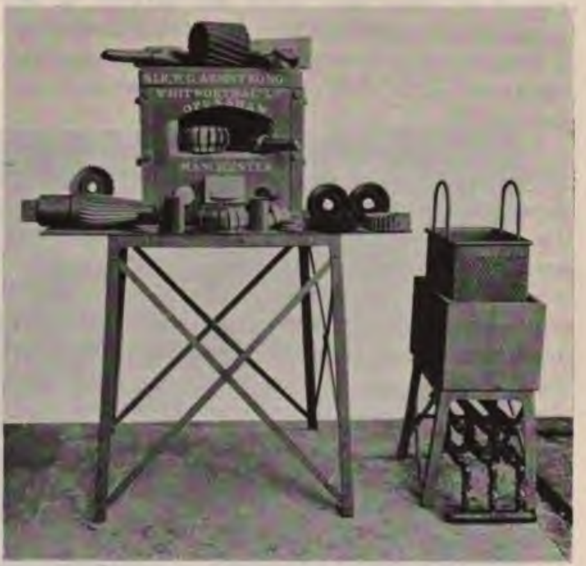

FIG. 2. MUFFLE FURNACE FOR HARDENING MILLING CUTTERS, ETC. ; ALSO TANK AND CAGE FOR TEMPERING IN OIL.

Before placing the cutters in the furnace it is advisable to fill up the hole and keyways with common fireclay to protect them.

The mode of procedure is now as follows :—

HARDENING PROCESS DESCRIBED.

The cutters are first placed upon the top of the furnace until they are warmed through, after which they are placed in the upper chamber (see fig. 2) and thoroughly and uniformly heated to a temperature of about 1,500 deg. F., or, say, a medium red heat, when they are transferred into the lower chamber, and allowed to remain therein until the cutter attains the same heat as the furnace itself, viz., about 2,200 deg. F., and the cutting edges become a bright yellow heat, having an appearance of a glazed or greasy surface. The cutter should then be withdrawn whilst the edges are sharp and uninjured, and revolved before an air blast until the red heat has passed away, and then whilst the cutter is still warm that, is just permitting of its being handled— it should be plunged into a bath of tallow at about 200 deg. F., and the temperature of the tallow bath then raised to about 520 deg. F., on the attainment of which the cutter should be immediately withdrawn and plunged in cold oil.

Of course there are various other ways of tempering, a good method being by means of a specially arranged gas-and-air stove into which the articles to be tempered are placed, and the stove then heated up to a temperature of from 500 deg. F. to 600 deg. F., when the gas is shut off and the furnace with its contents allowed to slowly cool down.

Another method of heating tools is by electrical means, and by which very regular and rapid heating is obtained, and where electric current is available, the system of electric heating is quick, reliable, and economical, and a brief description of this kind of heating may be of interest.

One method adopted of electrically heating the points of tools and the arrangement of apparatus is shown in fig. 1. It consists of a cast-iron tank, of suitable dimensions, containing a strong solution of potassium carbonate together with a dynamo, the positive cable from which is connected to the metal clip holding the tool to be heated, whilst the negative cable is connected direct on the tank. The tool to be hardened is held in a suitable clip to ensure good contact. Proceeding to harden the tool action is as follows:—

The current is first switched on, and then the tool is gently lowered into the solution to such a depth as is required to harden it. The act of dipping the tool into the alkaline solution completes the electric circuit and at once sets up intense heat on the immersed part. When it is seen that the tool is sufficiently heated the current is instantly switched off, and the solution then serves to rapidly chill and harden the point of the tool, so that no air blast is necessary.

Another method of heating the point of tools is by means of the electric arc, the heating effect of which is also very rapid in its action. The general arrangement and form of the apparatus here employed being as illustrated in fig. 3.

The tool under treatment and the positive electrode are placed on a bed of non-conducting and non-combustible material and the arc started gradually at a low voltage and steadily increased as required, by controlling the shunt rheostat, care being taken not to obtain too geat a heat and so fuse the end of the tool. The source of power in this case is a motor generator consisting of a continuous-current shunt-wound motor at 220 volts coupled to a continuous-current shunt-wound dynamo at from 50 to 150 volts. Arcs from 10 to 1,000 amperes are then easily produced and simply and safely controlled by means of the shunt rheostat.

TEMPERING.

Electricity is also a very efficient and accurate means of tempering such forms of tools as milling gear, hobbing and other similar cutters, also large hollow taps, hollow reamers, and all other hollow

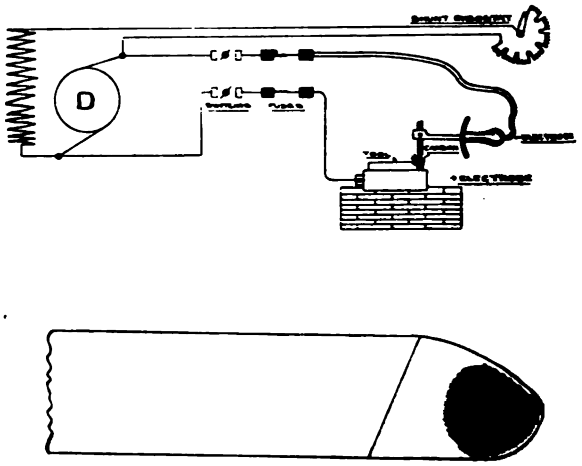

FIG. 3. APPARATUS FOR HARDENING HIGH-SPEED TOOLS BY MEANS OF AN ELECTRIC ARC.

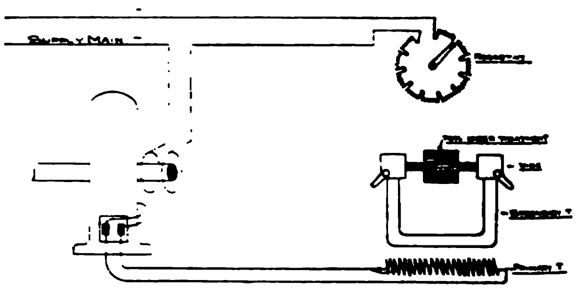

FIG. 4. APPARATUS FOR TEMPERING MILLING CUTTERS, ETC., ELECTRICALLY.

tools made of high-speed steel, where it is required to have the outside or cutting portion hard, and the interior soft and tenacious, so as to be in the best condition to resist the great stresses put upon the tool by the resistance of the metal being cut, and which stresses tend to cause disruption of the cutter if the hardening extends too deep.

By means of the apparatus illustrated in fig. 4, this tempering or softening of the interior can be perfectly and quickly effected, thus bringing the cutter into the best possible condition to perform rapid and heavy work.

Tempering of hollow cutters, etc., is sometimes carried out by the insertion of a heated rod within the cutter and so drawing the temper, but this is not entirely satisfactory, or scientific, and is liable to induce cracking by too sudden heat application, and further because of the difficulty of maintaining the necessary heat and temperature required, and afterwards gradually lowering the heat until the proper degree of temper has been obtained. In electrical tempering these difficulties are overcome, as the rod is placed inside the cutter quite cold, and the electric current gradually and steadily heats up the rod until the correct temperature is reached, when it can be held at such temperature as long as is necessary, and the current can be gradually reduced until the articles operated on are cold again, and consequently the risk of cracking by too sudden expansion and contraction is reduced very greatly. The apparatus used is very simple, as will be seen by reference to the sketch. It consists of a continuous-current shunt-wound motor directly coupled to a single-phase alternating-current dynamo of the revolving field type. The thermal effect of the current is used up in heating the mandril which gradually attains the required temperature, slowly imparting its heat to the tool under treatment until the shade of the oxide on the tool satisfies the operator.

The method adopted to regulate the heat of the mandril is by varying the excitation current of the alternator by means of the rheostat.

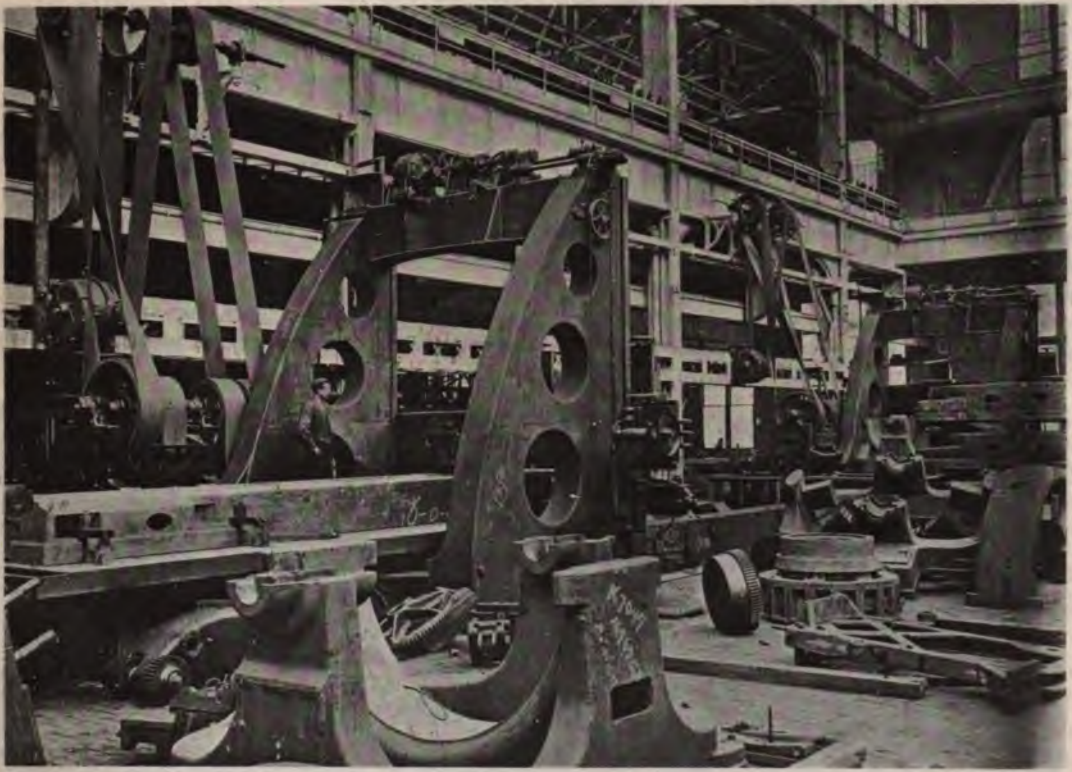

FIG. 5. PLANING MACHINES FITTED WITH MITCHELL'S PATENT DRIVE, USING "A.W." HIGH-SPEED STEEL.

Cutting speed, 36 ft. per minute, returning at 80 ft. per minute.

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* Paper read before the Iron and Steel Institute.

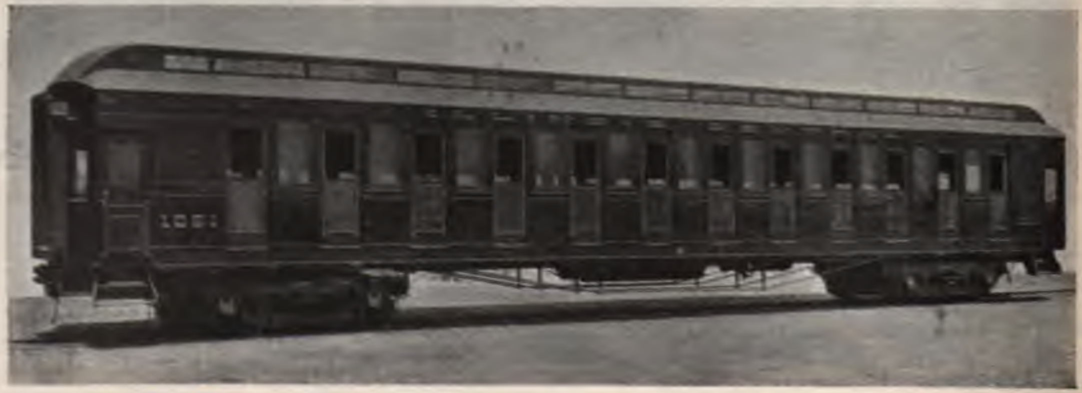
SUBURBAN RAILWAY TRAFFIC.

By A. W. Sullivan.

II.

NO material changes have been made in the type of car used for many years until recently, when the Illinois Central Railway built and placed in suburban service at Chicago during the year 1903 several trains consisting of cars of which the entire frame work is constructed of steel. These cars have fixed seats for 100 passengers, arranged in sections transversely of the car, with two aisles, one on each side, between the ends of the seats and the sides of the car, extending the entire length of the car and connecting at the vestibules with end-doors. Opening directly from the aisles are 24 sliding side-doors, 12 on each side. These doors are spaced equal distance apart throughout the length of the car, a door being opposite each section of eight seats. This arrangement of aisles and seats gives great facility to the movement of passengers when entering and leaving the cars, and provides for convenient movement not only throughout the car but throughout the train as well by means of the vestibules and end-doors which connect one car with another. When the side-doors are used, the station platforms are upon the same level as the floor of the car, but at stations where the platforms are low or upon the ground, the doors and steps at the vestibule ends of the cars are used by passengers when entering and leaving, the same as in ordinary end-door cars.

The side-doors slide within the walls, which are hollow, are connected by a mechanism which is operated either by compressed air or by hand in exclusive control of the guard, who rides within the cars, and upon arrival at a station, releases the mechanism so that the doors may be opened separately by the passengers, either from within or outside of the cars. When the passengers have left the cars and those to take the train have entered, the guard by means of the mechanism closes and locks the doors of each car simultaneously; and when all the doors of the train are thus closed and locked, an electric signal is given automatically to the engineman, who then starts the train. So rapid is this method of operation that 100 passengers have been discharged from a car at a terminal station in four seconds, and ordinary stops at intermediate stations where many passengers leave and enter the trains are made in six to eight seconds. The system of automatic electric signals connecting the side-doors with the locomotive admits of long trains being handled with the same facility and dispatch as short trains, and greatly increases all the operating efficiency of the train service.



STEEL-FRAME SIDE-DOOR SUBURBAN CAR ON THE ILLINOIS CENTRAL RAILWAY.
Showing side-doors closed.

STEEL-FRAME SIDE-DOOR SUBURBAN CAR ON THE ILLINOIS CENTRAL RAILWAY.
With side-doors open.

TRAIN RUNNING, SPEED, ETC.

The average over-all speed of suburban trains between the starting and terminal points of a representative section of line in the United States and Canada, is found to range as follows :—

Speed per hour	Number of railways.	Speed per hour.	Number of railways.
13 miles ..	.. 1	25 miles ..	.. 4
17 — ..	.. 1	26 — ..	.. 2
18 — ..	.. 1	28 — ..	.. 1
19 — ..	.. 1	30 — ..	.. 3
20 — ..	.. 1	35 — ..	.. 1
21 — ..	.. 1	37 — ..	.. 1
22 — ..	.. 5	38 — ..	.. 1
23 — ..	.. 2		—
24 — ..	.. 2		28

The average speed of the twenty-eight railways is 24·7 miles per hour.

In Argentina, the average speed is 31 miles per hour, and in Brazil 10 miles per hour.

The average time trains are at rest at intermediate stations for discharging and receiving passengers is 30 seconds. The greatest number of trains run in any one hour in one direction ranges from 1 to 50, the average being 9·5 trains. Ten railways follow the practice of stopping all trains at all stations within the suburban district, while twenty railways alternate non-stopping trains with stopping trains.

Under the practice of stopping all trains at all stations, as many as thirty trains are run in one direction in one hour on a section 26 miles in length with 18 stops; while under the practice of alternating non-stopping trains with stopping trains, the movement of fourteen trains in one direction in one hour is the greatest number reported on a section 12 miles in length, in which 14 stops are made by the trains which stop at all stations. There are no cases reported where precisely similar circumstances exist to enable exact comparisons to be made of the capacity for train movement under the two methods of operation, but it is manifest that the method of alternating stopping and non-stopping trains greatly reduces the capacity of the line for train movement.

The greatest number of trains run into the chief terminal station used by suburban trains in any one hour ranges from 1 to 53; the average being 14 trains.

The greatest number of trains run into and out of the chief terminal station used by suburban trains in any one hour ranges from 1 to 78, the average being 21 trains.

The number of trains—total of inwards and outwards—dealt with on an average week-day within the twenty-four hours ranges from 4 to 829, the average being 195 trains.

Four railways run trains at regular intervals throughout the day without increasing the number during the morning and evening hours. Sixteen railways run trains at regular intervals, supplementing with additional trains morning and evening; while eight railways run trains at irregular intervals to suit the requirements of the traffic.

None of the railways operate suburban trains throughout the night.

All railways report satisfactory service in the matter of punctuality of the working of suburban trains.

The successful results in respect to punctuality of trains are variously attributed to the following reasons :—

1. Suitable train schedules.

2. Efficient locomotives.

3. Good organisation.

4. Rigid discipline.

5. Prompt departure of trains from initial station.

6. Short stops and quick work at intermediate stations in discharging and receiving passengers.

7. Distribution of passengers to seats throughout the train after train has resumed motion.

8. Prompt and efficient methods of collecting tickets and fares.

Seventeen railways have no barriers at stations to prevent access to trains; seven railways have barriers which are closed at the time for departure of trains; two railways have barriers which are closed thirty seconds, and two railways one minute before the departure of trains.

NAME OF RAILWAYS.	Number of seats.	Length over end sills of underframe, in feet.	Number of wheels.	WEIGHT.			TOTAL WEIGHT	
				Body.	Trucks	Total.	per lineal feet.	per seat.
Atlanta & West Point	60	52·5	8	...	..	57,600	1,097	960
Baltimore & Ohio	56	49	8	42,920	16,080	59,000	1,204	1,054
Baltimore & Ohio Southwestern	56	45	8	33,050	15,000	48,050	1,068	858
Boston & Albany	82	61	12	35,230	28,720	63,950	1,048	780
Boston & Maine	65	50	8	32,400	21,700	54,100	1,082	832
	70	55	8	36,350	21,700	58,050	1,055	829
	77	60	8	44,100	23,300	67,400	1,123	875
Central of Georgia	56	50	8	...	..	50,000	1,000	893
	58	53	8	...	..	53.400	1,008	921
Central of New Jersey	60	51	8	36,900	17,000	53,900	1,057	898
Chicago, Burlington & Quincy	68	51	8	29,400	18,800	48,200	945	709
Chicago & Eastern Illinois	72	56	8	33,100	12,500	49,500	884	688
Chicago & Northwestern	60	52	8	41,500	17,000	58,500	1,125	975
Cincinnati, Hamilton & Dayton	64	51·5	8	36,000	17,400	53,400	1,037	834
Cincinnati, New Orleans & Texas Pacific	58	48	8	31,640	15,660	47,300	985	815
	60	52·5	12	33,260	27,040	60,300	1,150	1,005
	64	57	8	46,000	22,000	68,000	1,193	1,062
	68	57·5	8	46,000	22,000	68,000	1,183	1,000
	70	57·5	8	46,300	22,000	68,300	1,188	976
	80	67	12	72,100	37,100	109,200	1,630	1,365
Delaware, Lackawanna & Western	60	51	8	...	...	60,400	1,184	1,007
	66	52	8	...	...	68,500	1,317	1,038
Erie	58	52	8	...	...	57,150	1,099	985
	62	51	8	...	...	56,950	1,117	919
	66	52	8	...	...	64,200	1,235	973
	72	61	8	...	...	81,650	1,339	1,134
	78	60	8	..	..	69,350	1,156	889
Grand Trunk, Chicago	60	45	8	..	...	47,400	1,053	790
Grand Trunk, Montreal	58	50	8	...	...	46,350	927	799
Illinois Central, old cars	56	45	8	25,400	16,200	41,600	925	743
Illinois Central, new cars	100	64	8	61,400	23,000	84,600	1,323	846
Minneapolis & St. Louis	56	51	8	37,150	20,350	57,500	1,127	1,027
	60	52	8	39,150	21,350	60,500	1,163	1,008
New York Central & Hudson River	64	54	8	45,100	21,800	66,900	1,239	1,045
	72	60	12	50,800	36,200	87,000	1,450	1,208
New York, New Haven & Hartford	48	40	8	25,300	32,900	58,200	1,455	1,212
	57	45	8	29,300	15,700	45,000	1,000	789
	60	48	8	30,000	17,900	47,900	998	798
	69	60	8	45,000	35,600	80,600	1,343	1,168
Pennsylvania Company	58	46·5	8	29,150	19,000	48,150	1,035	830
	64	54	8	48,700	20,500	69,200	1,281	1,081
Philadelphia & Reading	66	52	8	41,320	11,140	63,600	1,223	964
Average	64·61	52·9	8	39,467	21,555	60,925	1,144	942

TABLE SHOWING DIMENSIONS, WEIGHT, ETC., OF ROLLING STOCK IN USE ON SUBURBAN LINES IN AMERICA AND CANADA.

CONCLUSIONS.

1. Suburban passenger traffic is found to consist in the safe and expeditious movement of large numbers of passengers for short distances at low rates of fare.

2. To be in the highest degree remunerative the traffic must be handled rapidly by methods that are simple and inexpensive, and with the minimum working organisation necessary for the purpose.

3. To obtain these results :—

(*a*) The station accommodation must be convenient and of ample capacity.

(*b*) The arrangements for passengers to go to and from the trains must be short and direct, and the station platforms level with the floors of the cars.

(*c*) Cars must be of large capacity, with side-doors to give the greatest freedom of movement for entrance and exit.

(*d*) Provision must be made for distribution of passengers throughout the train while in motion.

(*e*) Adequate safeguards must be provided for protection against personal injury, chiefly for the purpose of preventing passengers from entering or leaving the cars while in motion.

(*f*) Trains must be of the greatest capacity consistent with economical movement.

4. The car, as the vehicle of transportation and the primary unit, is the factor to which everything else must conform.

5. In the case of new lines to be constructed, the type of car should first be determined and the railway then designed to fit the car.

6. In the case of old lines, to develop the greatest transportation capacity, the car should be of such size as will utilise in the highest degree the space between tracks upon tangents ; the curves should then be compensated to provide the same clearances as upon tangents, in order to admit of the use of a car of the maximum size upon all parts of the line.

7. The locomotive should be proportioned to handle trains of maximum size at the speed demanded by the train schedules.

8. The track and bridges should have stability and strength requisite to safely and economically carry at speed the locomotives and trains required for maximum traffic movements.

9. The greatest train movement and the highest degree of safety and of economy in operation are to be attained by schedules which provide for the movement of trains at uniform speed and stopping at all stations, upon the same tracks.

10. That separate tracks should be provided upon lines of heavy traffic for trains which are run at high speed and do not stop at all stations.

11. That an essential requisite of economical operation is to conserve the expenditure of energy, and avoid the necessity of regaining time lost, by preventing the loss of time at stations.

12. To this end the prompt movement of passengers should be provided for, and no loss of time should occur in the departure of trains when the purpose for which a stop is made at a station has been accomplished.

13. That the frequency of train movement should be proportioned to the volume of traffic, to avoid congestion at stations.

14. The system which combines the foregoing requisites in the highest degree may be deemed the most perfect.

OBITUARY.

By the death of Mr. James Napier, Glasgow has lost a prominent member of the iron trade.

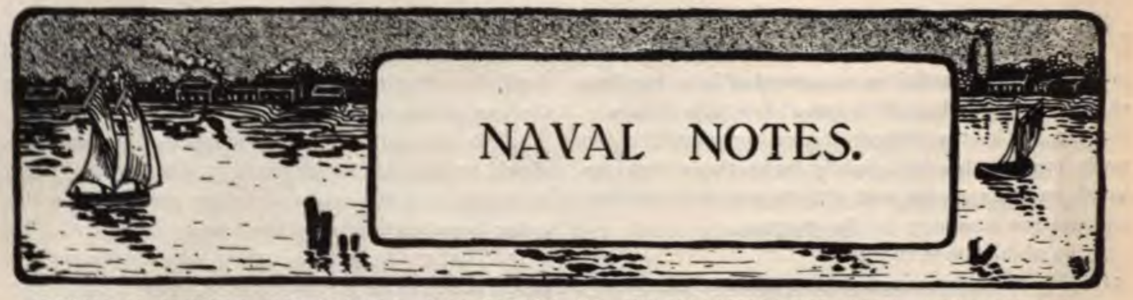
Earl Cairns, who died suddenly at Cannes on Saturday last, was the third son of the great Lord Chancellor. The bent of his mind was towards engineering, and he worked for some years in Sir W. G. Armstrong, Whitworth and Co.'s gun factory. At the time of his death he was a partner in the Elswick Ordnance Company.

The death is reported of Mr. James Kerr, of Aintree. Mr. Kerr was connected with the Lancashire and Yorkshire Railway for a period of over forty years.

Mr. Thomas Fenwick, the well-known Leeds civil engineer, lived to the ripe age of eighty, and his recollection carried him back to the beginnings of railway locomotion, he having been associated in his early years with both George and Robert Stephenson. He was originally a member of the engineering firm of Martin and Fenwick, of Leeds, but in later years was joined in business by two of his sons, and in conjunction with them was closely identified with the development of Leeds.

The news of the death of Mr. James Harvey Williams, the president of the well-known Brooklyn firm Messrs. J. H. Williams and Co., has been received with much regret on this side. The firm under Mr. Williams, presidency, won its present reputation as makers of drop forgings.

The death is announced of Mr. William Beswick Myers-Beswick, a well-known member of the leading engineering institutions. He was for a good many years a partner in the firm of John Fraser and Sons, Leeds, and was concerned in the construction of a good deal of Great Northern line in Yorkshire.



NAVAL NOTES.

WEEKLY NOTES ON NAVAL PROGRESS IN CONSTRUCTION AND ARMAMENT.

(BY OUR NAVAL CORRESPONDENT.)

DURING the past fortnight we have had much evidence of the great changes which are being brought about by the new scheme of distribution. In all 116 vessels have been put into commission in reserve, comprising nine battleships, twenty cruisers, two torpedo gunboats, forty-two destroyers, and forty-three torpedo boats, and of these six battleships and six cruisers are on the emergency list. The Admiralty return of last March showed that in all there were fifty-seven battleships which counted as effective vessels. Only two of those vessels are included in the ships to be struck off the effective list, and to-day, including all the *King Edwards* which did not figure in that return, there are only sixty-five. There is a saving, however, in the annual upkeep of thirteen old vessels, quite inefficient and not included in the return, which could only be regarded at best as forlorn hopes. Thirteen armoured cruisers, forty protected cruisers, thirty-six gunboats and torpedo gunboats, and twenty-one sloops, hulks, etc., are also transferred to the sale list, and are being removed from the dockyards to the various mooring grounds which have been decided on. Some forty or more are destined for the Motherbank, a large number also will be taken to the Kyles of Bute, and the remainder will be distributed in various locks and creeks around the coast.

Arguments for and against battleships of moderate dimensions continue to be bandied about, but the fact that no fewer than forty vessels of 16,000 tons and over are building for various Powers is sufficient proof that the trend of thought in the Admiralty Departments of the Powers is not towards the small battleship. The fact that Germany does not build such leviathans is easily explained by the necessity for her vessels to be of moderate displacement for use in the comparatively shallow waters of the Baltic and the North Sea. In the meantime we are proceeding with the construction of large vessels, and last week the keel plates of the armoured cruisers *Minotaur* and *Shannon* were laid down. The battleship *Hindustan*, of the *King Edward* class, has completed her trials, and the *Hibernia*, which is building at Devonport is ready for launching. She will not, however, be put into the water until July, and she will then be in a very advanced state. The *Sentinel* scout has also completed her trials with very satisfactory results, attaining a speed of 25 knots. The *Sapphire* and *Diamond* third-class cruisers are now almost ready to receive their nucleus crews, and will shortly proceed to join the Reserve divisions at Sheerness, Chatham, and Devonport, respectively.

Launches of three torpedo-boat destroyers have taken place since the beginning of the New Year, the *Ness* on January 5th, and the *Gala* and *Ouse* on January 7th.

The announcement has been made, and there seems to be no reason to doubt its accuracy, that Captain Percy Scott is to be made the head of a new department at the Admiralty, with the title of "Director of Target Practice," or some similar designation. The American navy has long possessed such a department, and there is every reason to believe that it would have been greatly beneficial to the shooting of the British Fleet if this reform had been earlier introduced. Captain Percy Scott is one of the best known men in the Service, and there can be no doubt about the popularity of his appointment to the Directorship of the new department. The gunnery efficiency of our fighting Fleet is not perhaps all that it might be; but, with an officer of Captain Scott's experience at the head of affairs, aided by an adequate staff of gunnery experts, with full powers, the standard of our shooting can conceivably be raised to very great heights. It may be noted in this connection that a new gun, to be known as the 12 pr. (18 cwt.) quick-firer gun has been ordered for issue to the Navy. It is stated to be greatly superior to the present 12 pr. (12 cwt.) gun, and the improvements in the breech lock are stated to enable more rounds to be fired per minute, with greater velocity, accuracy of aim and range.

THE WEEK AMONG THE TECHNICAL SOCIETIES.

INSTITUTION OF ELECTRICAL ENGINEERS.

FUEL ECONOMY IN STEAM-POWER PLANTS.

AN ordinary general meeting of this Institution was held at the Institute of Civil Engineers, Great George Street, Westminster, on January 12th.

The paper on the agenda was "Fuel Economy in Steam-power Plants," by Messrs. Wm. H. Booth and John B. C. Kersham.

The following is an abstract of the paper :—

Economy in most or all electrical-power plants as usually understood is at present unattainable. In the case of a lighting station, the possession of a really durable and efficient storage battery would raise the load factor probably eightfold. In the case of the traction power-house economy in the fullest sense is a question of accumulators.

The authors assume that the fullest economy of first cost, and more especially of running cost, are recognised by all station engineers as only obtainable in the present state of knowledge by means of a battery. But they are also aware that the battery is so far from perfect that its adoption in any case must still be a matter of grave and careful deliberation.

Steam-power economy is to be secured by attention to fuel and its combustion, feed-water and its treatment and heating, furnace design and arrangement, steam treatment and its use in suitable engines.

Most electrical engineers admit the importance of attention to the physical and chemical characteristics of their feed-water supply, and they recognise the impossibility of obtaining the highest efficiency from their boilers, if the water is passed into them without preliminary heating, carrying all the original suspended dirt and dissolved impurities. The authors direct attention to the increased efficiency which is obtained from boilers fed with water at or above 212 deg. F., the real cause of which is not yet determined, although a possible explanation lies in the avoidance of merely mechanical work, the heat energy of the fuel being devoted in the boiler to the conversion of the water into steam.

FUEL SUPPLY.

The importance of the fact that fuel represents 50 per cent. of the total works cost in the generation of electricity, and that from 10 to 20 per cent. of this outlay can be saved, is often ignored by engineers when contemplating the low price at which they have placed their fuel contracts.

But a 10 per cent. saving on the total works costs is worth effecting, even when these costs are exceptionally low ; and systematic sampling and testing of the fuel would in many cases be found to save money. The testing of fuel for technical purposes should cover moisture, ash, coke, volatile matter and calorific value ; the last being calculated from the approximate analysis and also ascertained by burning from ½ to 2 grammes of the fuel in one of the various forms of fuel calorimeters.

The authors assert that with suitable furnace construction and scientific control, bituminous fuels can be burnt without causing smoke troubles and with high efficiency under every type of boiler, and that great savings in fuel costs could be effected in this direction. But the furnace construction must be adapted to the fuel, and it is absurd to suppose that furnaces designed for burning anthracite or semi-anthracite fuel, will satisfactorily burn fuels containing 30 per cent. or more of volatile matter. The percentage of volatile matter which a fuel gives off when heated is, in fact, a measure of the size of the chamber required for its complete combustion, and it is here that the laboratory examination of fuel yields results of the greatest value. That such an examination is still regarded as unnecessary and of no help in the placing of fuel contracts, is clear proof of how much has still to be learned in the scientific control of steam plant.

Too little attention has certainly been given in the past to the question of adapting the furnace construction and methods of firing to the fuel, and whatever boiler-makers chose to recommend has been much too readily accepted. Most of the electricity works where high-priced fuel is now being used, because it is asserted that steam cannot be kept up or that smoke is produced, when burning cheaper fuel, are simply playing into the hands of the South Wales coal companies.

CAUSES OF LOW INITIAL FURNACE TEMPERATURE

The most important causes of low initial furnace temperature are, excessive air supply to the furnaces, and too sudden contact of the half-burnt gases, with the water-cooled tubes or plates. Larger combustion chambers and refractory furnace linings are the proper remedy for the latter evil, and gas-testing is the check and remedy for the former.

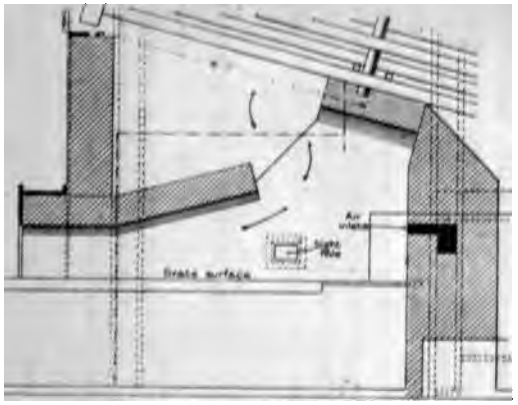


FIG. 2. REFRACTORY FURNACE OF BABCOCK BOILER (KENSINGTON AND NOTTING HILL).
Form—Correct. Environment—Good.

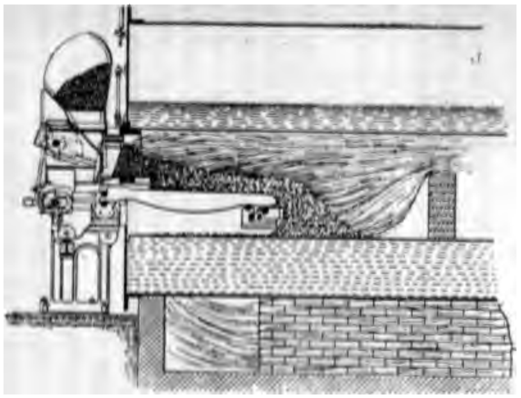


FIG. 4. VICARS STOKER, WITH SHORT GRATE AND GAS PRODUCER PIT.

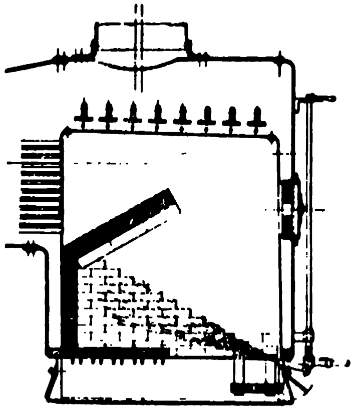


FIG. 6. LOCOMOTIVE BOILER, BRICK-LINED FOR LIQUID FUEL.

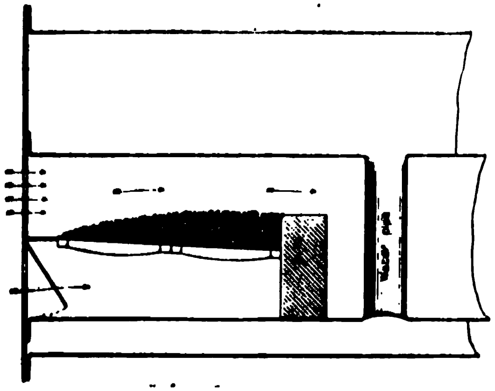


FIG. 3. ORDINARY FURNACE OF LANCASHIRE BOILER.
Form—Correct. Environment—Bad.

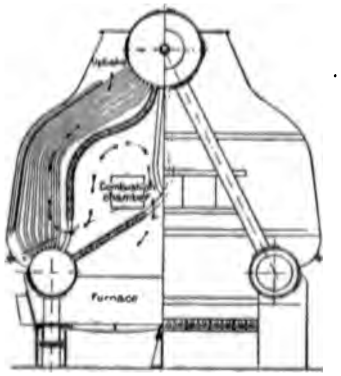


FIG 5. WEIR WATER-TUBE BOILER, WITH REFRACTORY FURNACE AND COMBUSTION CHAMBER.

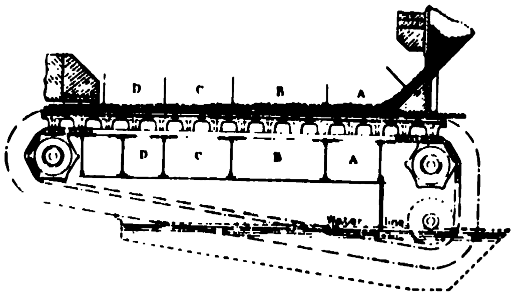


FIG. 7. CHAIN GRATE STOKER, WITH AIR-REGULATING CHAMBERS BELOW.

Furnace temperatures might, in many plants, be raised 500 deg. or 1,000 deg. F. by attention to these two points alone, but even then the limit of what is attainable in this direction would not be reached. By the use of a heated air supply in conjunction with closed-in ash-pit and induced or forced draught, much higher temperatures can be attained in the boiler furnace; and should Rowan's suggestion for working such furnaces under two or three atmospheres pressure be adopted, further increases of 715 deg. F. and 493 deg. F. could be attained. The possibility of obtaining far higher evaporative efficiencies from boiler plants, than any yet attained, by intensifying the combustion along these lines, is therefore strikingly manifest, and it is surprising that hitherto so few attempts have yet been made to put these suggestions to a practical trial in new plants or extensions.

The limit of improved efficiency possible in this direction is that imposed by the ability of the steel used for boiler construction to withstand very high temperatures under steam pressures of 150 or 200 lb.; but no doubt the resisting qualities of steel plates in this respect could be greatly improved, and the more general use of refractory linings to the boiler furnaces would also assist in meeting this difficulty.

BOILERS AND FURNACES.

The authors point out that for long-continued steady work, such as electric tramway work, the large shell type of boilers, such as the Lancashire and Marine is very suitable, that for lighting work and large installations the large water-tube boiler is a good type to use, while the small water-tube boiler is suitable for the peaks of loads of short duration, and can be heavily forced without danger.

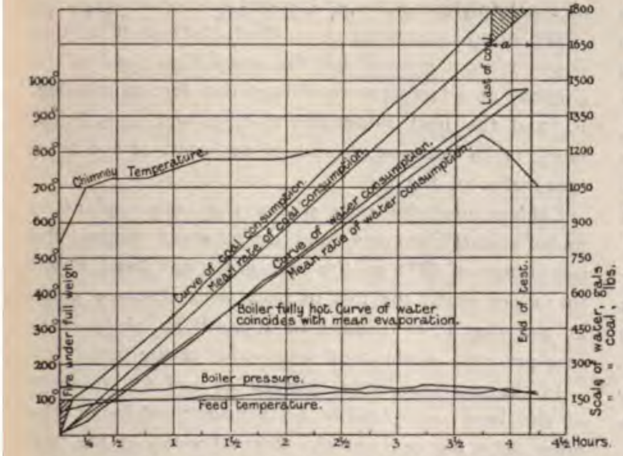


FIG. I. BOILER-TEST CURVES SHOWING HEAT STORAGE IN BRICK CASING OF SOLIGNAC BOILER.

In every case there are certain stand-by losses to be reduced by attention to air-tight brickwork and heat insulation. The type of boiler to be employed is less a matter of heat storage than of rapidity of steaming from colder conditions. Once the temperature of full pressure has been attained, the boiler containing much water will answer as rapidly as the flash boiler to an increased urgency of fire. The conditions of an electric light station may be held to point to the use of light water-tube boilers of the Express type fired by liquid fuel. This policy will be the more suitable as the load peak becomes of greater height and shorter duration.

Where coal is the fuel the provision of a second supply will present difficulties that may be more serious than the provision of more boilers; but with a system of liquid fuel, the conveyance of the fuel to the furnaces is a simple matter, and it may well pay to employ expensive liquid fuel during heavy loads of short duration, if capital outlay is thereby reduced together with rent and attendance. This seems for Great Britain at least the proper use of liquid fuel. Any more general employment of liquid fuels would deplete the market and raise prices.

The Lancashire or Shell type of boiler has the advantage of small heat-radiating surfaces and whereas with most water-tube boilers there are at least two side walls to every two boilers, there are only two side walls to any number of Lancashire boilers, heat-radiation being confined to the front end and top. The chief disadvantage of this type of boiler is the furnace. For small stations the shell boiler offers better prospect of steady pressure.

Though the water-tube boiler does not possess the steady steaming qualities of the larger shell boiler, this fault decreases as the number of boilers increases. It is more apt to prime, and it has greater liability of stand-by losses, and larger radiation losses and maintenance. Being externally fired, it possesses great furnace potentialities which are easily secured. The water-tube boiler can take full advantage of the external furnace provided that the process of combustion is allowed to be carried out in conformity with the known facts of physics and chemistry.

The small tube boiler is merely another step forward in the process of splitting up the heating surface and reducing water contents.

Fig. 1 shows that even with a boiler of the Solignac type considerable heat is absorbed by the brick-lining of the casing so that the full output of steam does not begin for some time. Hence the bend at the beginning and end of the coal and water lines in the diagram, showing heat absorbed and given off by the brickwork.

These small boilers appear to offer themselves for supplying emergency steam. Fired by liquid fuel, some of these boilers, such as the Solignac, could instantly be put in full work if filled up with fully-heated feed-water from a thermal store tank. The full fire might be started almost as soon as the water had been turned into the empty boiler.

TYPES OF FURNACES COMPARED.

The economy possible from many appliances lies entirely in the possibility of using a cheaper fuel. The three essentials for the proper use of bituminous coal are a furnace so arranged that the gases given off the green fuel and air to burn those gases shall travel over the length of the fire together, under a draught velocity of not less than 30 ft. per second. The mixed gases must have free unencumbered space beyond the furnace in which to complete combustion, and this combustion will be complete if the third essential of temperature be present.

In shell boilers of the Lancashire type without cross tubes, with roomy brick flues and a 200 ft. chimney, a careful hand stoker will burn bituminous fuel without smoke.

The ordinary furnace of the usual types of water tube boiler is hopeless. No perfect combustion can possibly take place where the gases rise vertically from the grate and pass directly between the cold tubes above. The essential sweeping effect is absent; there is no air mixture, and there is no sufficient temperature.

The water-tube boiler, in common with most or all externally fired boilers, can be supplied with a furnace of perfect form, of refractory material, and with suitable air admission. Such a furnace will be smokeless and economical. The water-tube boiler has thus undoubted potential advantages over the shell boiler which has a furnace, perfect it may be in form, but covered with a water-cooled arch difficult to line with refractory temperature-conserving material (figs. 2 and 3). In existing stations, with floor lines fixed, basements occupied, and pipes difficult to alter, the change to good furnace conditions may involve considerable difficulty, but, in laying out new plant, it should be possible to afford the necessary head room to give good furnace arrangements.

In Fig. 2 is a furnace which has been shown effectually to burn bituminous coal without smoke, but, so far as the authors are aware, this furnace has only been used with ordinary chain grates, and there is no ordinary chain grate that does not pass an unnecessary and grossly excessive volume of air. Until this furnace is tried with a less wasteful form of grate, no absolute opinion can be passed upon its proportions though its principles are correct.

Fig. 5, which shows the Weir water-tube boiler, is an example of the same principle, scarcely different in the way it is carried out. Coal is burned in the **A**-shaped furnace, the walls on all four sides of which are of fire brick, and combustion is continued in a similarly protected chamber, and is perfect with ordinary hand-firing before the heated gases pass among the tubes. Fig. 6 shows the locomotive furnace similarly arranged to secure correct form. The chain grate stoker is perfect as a self-cleaning contrivance, but admits excessive air. Hence the need of choking boxes, as employed by Mr. E. B. Coxe (fig. 7).

The ideal mechanical stoker is of the inclined grate type in which the inevitable thinning of the fire of the cooking furnace is made good by the aid of a moving grate assisted by gravity. In this type, only possible in its full extent with external furnaces, the fuel is helped to fill gaps and close the lower end of the fire by gravity, and at the foot of the inclined grate is some arrangement which enables ash and dirt to be removed.

THE WASTE GASES.

The temperature and chemical composition of the waste gases passing from every large boiler-plant ought to be regularly ascertained. The absence of smoke is no guarantee that combustion is being carried out in an economical manner, and only by constant testing of the exit gases can one be certain that the fuel is being burnt, without undue excess of air. The significance of air excess becomes manifest when one considers the following figures: With gases containing only 4 per cent. of CO_2 and a chimney temperature of 400 deg. F., 4,380 B.Th. units are lost for every pound of fuel burnt, *i.e.*, 32·4 per cent of the total heat value of the fuel.

Where no economiser is installed, the loss of heating power is even greater, for the gases then pass to the chimney at a temperature of from 600 deg. to 700 deg. F., and the heat losses rise to 6,750 and 7,665 B.Th. units, or to between 48 and 50 per cent. of the total heat value of the fuel.

Taking now the case where the boiler plant is under scientific control, and by constant testing the percentage of CO_2 in the exit gases has been raised to 12 per cent., the loss of heat with chimney gases at 400 deg. F. is reduced to 1,540 B.Th. units, or to 11·4 per cent. of the total heat value of the fuel.

In the one case, only between 44 and 68 per cent. of the heat can possibly be utilised; while in the other, 88·5 per cent. of the thermal value of the fuel may be converted into useful work—either in the boilers or in the feed-water apparatus.

INSTITUTE OF MARINE ENGINEERS.

PRESIDENTIAL ADDRESS BY THE HON. C. A. PARSONS.

At the meeting held on Monday last at the Institute, Romford Road, Stratford, E., the Hon. C. A. Parsons delivered his Presidential address, of which the following is an abstract:—

As to the probable development of the turbine in the future for marine work, with the evidence at present before us, Mr. Parsons thinks it safe to predict that it will soon entirely supersede the reciprocating engine in vessels of 16 knots sea speed and upwards, and of over 5,000 i.h.p., and probably also including vessels of speeds down to 13 knots of 20,000 tons and upwards, and possibly to still slower vessels in course of time. At the present it may be said that the above most suitable field comprises about one-fifth of the total steam tonnage of the world; but it must be remembered that the speed of ships tends to increase, and the turbine to improve, and so the class of ships suitable for the turbine will increase.

TURBINES AND TRAMP STEAMERS.

It seems probable also that a combination of the reciprocating engine and the turbine will be found the best machinery for vessels of the tramp class in the immediate future. This field is a very large and important one, deserving of more attention than it has as yet received, and is worthy of the most earnest consideration.

The case may be put thus: In a slow vessel, say of 10 knots speed, the revolutions must be low, because a certain disc area of propeller and a certain number of square feet of blade area are necessary in order to avoid too great a slip ratio and consequent loss of propeller efficiency. It is also proved by experiment that the pitch ratio cannot be reduced much below ·8 without commencing to incur excessive loss from skin friction of the blades. There is no alternative but to accept the highest revolutions possible under the circumstances, which in a 10-knot vessel is a low figure.

To obtain a reasonable economy from a turbine a certain surface speed of the turbine blades is essential as well as a certain number of rows of blades. If the revolutions are low, the diameter and also the number of rows must be increased in order to maintain the economy. The result is that for ten knots the diameter and number of rows become inordinately great, the weight and cost become excessive, and also, added to this, the efficiency of the turbine is somewhat impaired by such extravagant dimensions in proportion to the power realised. Experimenters are, therefore, blocked on these lines, and must choose some other course.

Fortunately there is a way out of the difficulty by which there can be obtained the full measure of expansion essential to economy, a superior economy to the best set of tramp engines in existence. It is now quite possible to make a turbine to deal economically with very low pressure steam, and to expand this low pressure steam thereby fully and economically and yet with a turbine of moderate cost and of slow revolutions.

If the indicator cards of a tramp are examined, it is found that the steam is usefully expanded down to about 7 lb. pressure absolute, and that it is then released into the condenser and the remaining energy between 7 lb., down to say, 1½ lb., or 27 in. vacuum, is almost entirely lost. Now what the turbine can do is to save, say 70 per cent. of this wasted power, and apply it to help to drive the vessel. The additional power gained by the use of this low-pressure turbine has been calculated to be between 15 per cent. and 20 per cent. of the whole now realised, a gain of the same order as was obtained in the advance from the compound to the triple engine. This is the main feature of the case; minor points, of course, there are, such as improvements of the condenser (as a good vacuum is very essential to all turbines for the best results) and also feed-heaters fed from the exhaust of auxiliaries or low-pressure steam drawn from the main engines for heating the colder feed due to the higher vacuum; and there are also other minor points, but it is clear that some arrangement such as is indicated will be largely used for the tramp engines of the near future.

THE MARINE GAS ENGINE.

Some reference should be made to the marine gas or oil engine as the possible, and, indeed, the probable and extensive competitor of the steam engine in the future. On land, the gas and oil engines have been so far perfected as to realise a horse-power on a consumption of from half to two-thirds that of the best condensing steam engine. Unfortunately for the gas and oil engine, it cannot yet be said that they can generally subsist on ordinary bunker coals. They must yet, as a rule, have anthracite coal, coke, or oil, and the result is that as yet their fuel is about double the price of that consumed by the steam engine. There are many workers in the field, and if, in the future, some form of gas producer using ordinary coal is successfully applied for use on board ship (which seems probable), and if the mechanical details of reversing can be satisfactorily arranged (as also seems probable), then the steam engine or steam turbine will have to give place to the gas engine. But changes of this character take a considerable time to accomplish.

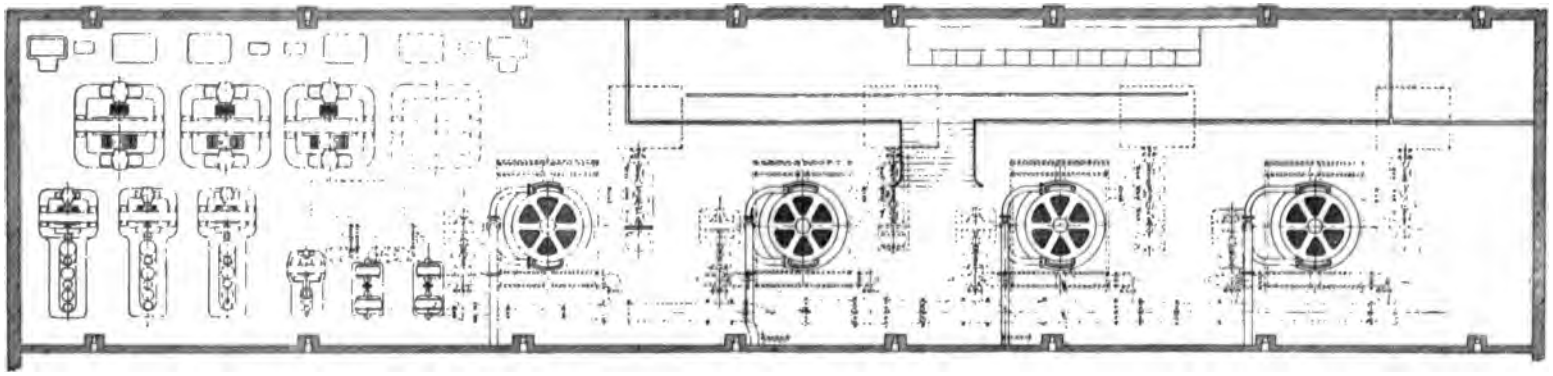


FIG. 3. PLAN OF ENGINE-ROOM, WITH FOUR 5,000 K.W. CURTIS TURBO-GENERATORS AND AUXILIARIES.

Superficial area about 10,600 sq. ft., equal to half a sq. ft. per k.w. of the main-engines.

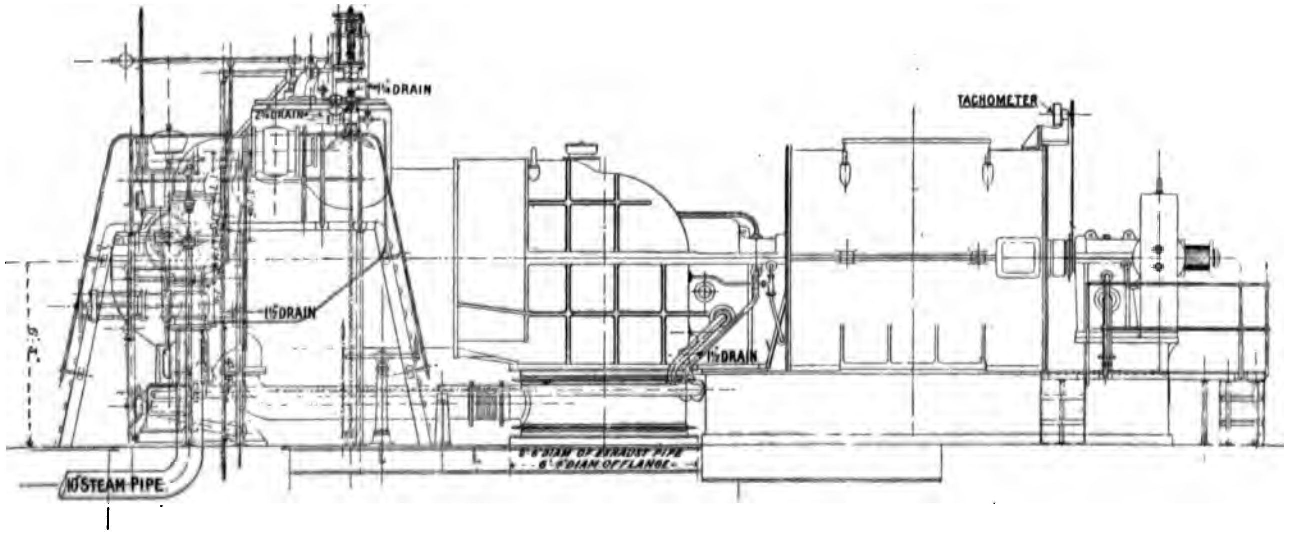


FIG. 4. 3,500 K.W. STEAM TURBINE ALTERNATOR, CONSTRUCTED BY MESSRS. C. A. PARSONS AND CO. FOR CARVILLE POWER STATION.

Weight of machine 93 tons ; speed 1,200 revolutions per minute, In the early part of the last century the evolution of improvements was exceedingly slow; towards the end of the century development was more rapid. In scientific, engineering, chemical, and all other fields of work the pace is increasing, owing to better education and the more general diffusion of knowledge, more highly developed institutions, colleges, and factories for research and so on, and also owing to the greater general accumulation of the wealth of nations. There exists at the present day an unprecedented amount of potential energy for advance, and the advance of the gas engine in the field of marine propulsion may come more rapidly than any of us expect.

In these days of rapid advance, it is of the highest importance that marine engineers should be well versed in the machinery under their charge, and also have as much knowledge as possible of the general principles upon which the design has been based. They will then be in the position not only to get the best results from the machinery under their charge, but also to afford the most valuable assistance to designers and constructors of machinery.

MANCHESTER ASSOCIATION OF ENGINEERS.

A COMPARISON OF DIFFERENT TYPES OF STEAM TURBINE.

At the meeting of this Association held on Saturday last, Mr. R. M. Neilson read a paper on this subject.

The following is a summary of certain parts of the paper:—

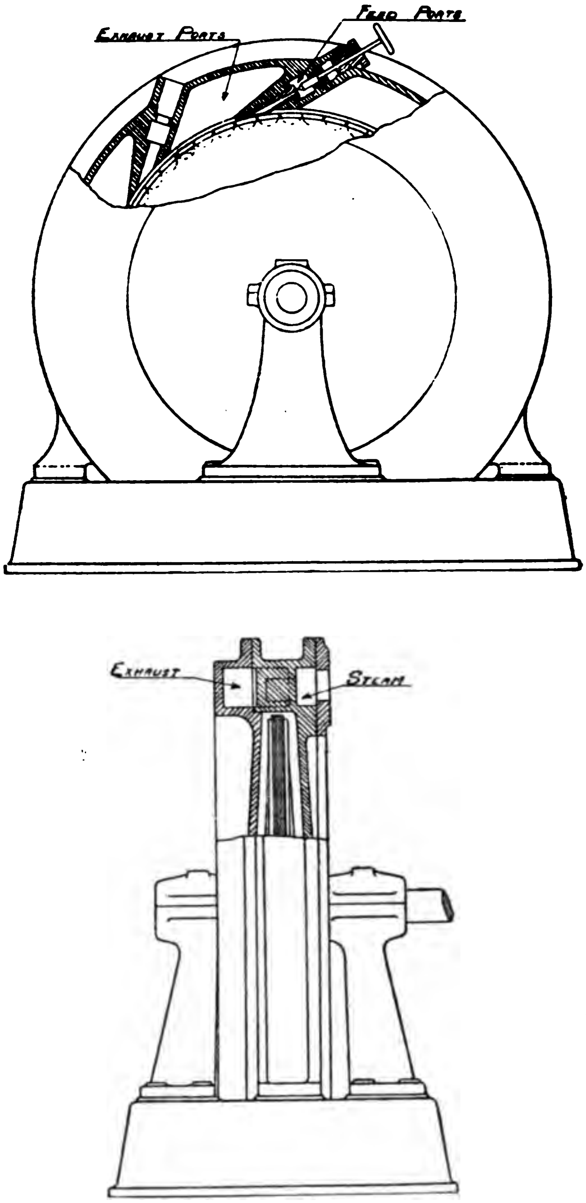
Figs. 1 and 2 illustrate a Primrose and Schill reversible steam turbine. The wheel is composed of plates of which every alternate one is scalloped out as shown, while the intervening plates are left uncut. The steam is expanded in diverging nozzles controlled by valves, and acts not only on the hollows of the scalloped plates but also by friction on the sides of the uncut plates. To reverse the turbine it is only necessary to direct the steam on to the wheel by an alternative set of nozzles inclined in the opposite direction, the wheel being equally suitable for rotating in either direction.

The author divides turbines into six different groups, according to the manner in which the steam is expanded. He does not approve of the division into two classes only, impulse and reaction steam turbines.

The friction between the rotating parts of a steam turbine and the fluid in which they rotate is a most important quantity, and it is one of the chief points to be considered in designing or evolving new forms or methods of working in connection with steam turbines.

ENGINE-ROOM STATISTICS.

Fig. 3 is a plan of the engine-room of a power station having four 5,000 kilowatts Curtis turbo-generators, besides auxiliaries. The floor space has a superficial area of about 10,600 square feet, which works out at a little over half a square foot per kilowatt of the main engines.



FIGS. 1 AND 2. PRIMROSE AND SCHILL'S REVERSIBLE STEAM TURBINE.

Steam expanded in diverging nozzles controlled by valves

Fig. 4 shows one of the two 3,500 kilowatt steam turbine alternators supplied by Messrs. C. A. Parsons and Co. to the Newcastle-on-Tyne Electric Supply Company Ltd., for their Carville Power Station, Wallsend. The total length of the turbo-alternator is about 37 ft., or, including the platforms and the stairs or ladders leading to these about 40½ ft. The extreme breadth is about 11½ ft., and the extreme height about 14½ ft. The weight of the machine is 93 tons, and the speed of rotation 1,200 revolutions per minute. The two machines are arranged side by side with their centre lines 20 ft. apart. This gives a space of an average width of about 12 ft. between the machines and the rectangle required by the two machines, and this intervening space amounts to about 1,357 square feet (33½ by 40½).

The dimensions, weights, and some other particulars of turbines of several different types are given in the Table where they can be compared. The engine-room floor works out at two-thirds square feet per kilowatt of the main engines. The Brown-Boveri-Parsons horizontal machines have 33·3 per cent. more ground than the vertical Curtis machines. There is no doubt that the vertical arrangement of the Curtis turbine gives it an advantage as regards floor space required, but on the other hand it calls for greater head room. Whether a power house for large vertical Curtis turbines can be constructed cheaper than one for turbines of equal power of the Parsons type is a question the answer to which is not by any means obvious.

HOW TO SECURE STEADY RUNNING.

Four methods are employed for getting steam turbines to run steady: (1) By keeping the angular velocity below the critical speed; (2) By running the machine above its critical speed, but providing yielding bearings to allow the rotating mass to choose its own axis of rotation; (3) By running the machine above its critical speed, but mounting the rotating mass on a flexible shaft to allow it to choose its own axis of rotation; (4) By running the machine above its critical speed, but balancing the rotation mass to kill vibration.

The first method is commonly adopted in large power turbines. The second method is adopted in the smaller Parsons turbines. The third method is adopted in the De Laval turbine, and in the higher speed Zoelly turbines. The fourth method is generally adopted in Riedler-Stumpf turbines.

The power and the steam consumption of a steam turbine can be reduced by reducing the aggregate area of the first nozzles or steam passages directing the steam on to the first set of moving vanes; by reducing the density or temperature of the steam supplied to these nozzles or passages; by reducing the time during which these nozzles or passages are passing steam; or by raising the exhaust pressure.

The first method is adopted in the De Laval, Rateau, Curtis, and Riedler-Stumpf turbines, the second in the Zoelly turbine, the third in the Parsons' turbine, while the last method could be advantageously employed with condensing turbines,

—Particulars of Steam Turbines of different Types.

Machine and Maker.	Rated Power.	Greatest Vane speed in feet per sec.	K.E. in rotating parts (Flywheel capacity).	Floor Space.		Height in feet.	Weight in Tons.	Revs. per minute.
				Area in sq. ft.	Lgth & Bdth in feet.			
Turbo generator. Makers: The Westinghouse Machine Co.	5,500 k.w.	350			Lgth 45·8 Bdth 13·2	14	268 with generator 176 without ,,	750
Brown-Boveri-Parsons turbo-alternator for Power Station of the Compagnie Russe - Française de Chemins de Fer et Tramways at St. Denis, France	5,000 k.w.	262	3,203,125 kg. metres.		Lgth 47·5 Bdth 13·5	11	150	750
Turbo-alternator constructed by Messrs. C. A. Parsons & Co., for the Carville Power Station of the Newcastle-upon-Tyne Electric Supply Co., Ltd. ..	3,500 k.w.				Lgth 37 Bdth 11·5	14·5	93	1,200
Westinghouse-Parsons turbo-alternator at the Pearl Street Station of the Hartford Electric Light Co., Hartford, Conn., U.S.A. Makers: The Westinghouse Machine Co.	1,500 k.w.				Lgth 33·25 Bdth 8·75		78	
Curtis turbo-alternator, British Thomson-Houston Co.'s standard design	1,500 k.w.						78, including condensing plant.	1,000
Turbo-alternator, standard design of The Brush Electrical Engineering Co., Ltd. Turbine of the Parsons type	1,000 k.w.	350	3,500,000 ft. lbs. without alternator.	124 turbine only without alternator.	Lgth 15·5 turbine only without alternator.		15 approx. without alternator.	1,500
Westinghouse Parsons turbo-alternator at Power House of Westinghouse Air Brake Co., Wilmerding, Pa., U.S.A. Makers: The Westinghouse Machine Co.	300 k.w.			75		7·75	11·2	3,600
Parsons turbine, made by C. A. Parsons & Co. ..	250 k.w.							3,000
De Laval turbine-dynamo, standard design, of Messrs. Greenwood & Batley, Ltd.	300 BHP	1,378			Lgth 13·75 Bdth 6·916	5·5	11·5	750

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts

CONTRACTS OPEN.

	Last Day.
Bamford.—Manufacture and supply of cast-iron pipes for a section of Derwent aqueduct for Derwent Valley Water Board. Mr. O. B. Steward, Bamford via Sheffield	Jan. 23
Grimsby.—Supply of plant and material for electrical department. Mr. W. A. Vignoles, Corporation Electricity Works, Grimsby (three specifications)	Jan. 23 Feb. 1
Swindon.—Supply and erection of Lancashire boiler with downtake superheater, etc., for Corporation. Mr. J. G. Griffin, Electricity Works, Swindon	Jan. 24
South Indian Railway.—Supply of 100 steel covered goods wagons, spoke wheels and axles and laminated bearing springs. Mr. Henry W. Notman, Managing Director, 55, Gracechurch Street, E.C.	Jan. 24
Netherlands.—Supply of ironwork, soft steel, general ironware, corrugated galvanised soft steel sleepers, metal superstructures for bridges, etc.	Jan. 25
Cardiff.—Construction of sewerage disposal works, supply and erection of gas engines etc., for the Llandaff and Dinas Powis Rural District Council. Mr. H. Warren, Clerk, Park Place, Cardiff	Jan. 26
Harrogate. — Supply and delivery of welded steel pipes and other materials in connection with the Masham Scheme Works; to be delivered at Ripley Station of the North-Eastern Railway. Mr. Edward Wilson Dixon, Engineer, Albert Street, Harrogate	Jan. 28
Bradford.—Supply of steel girder, tramway rails, fishplates, steel poles. etc. Mr. Frederick Stevens, Town Clerk	Jan. 28
Chertsey. — Construction of two bridges across River Wey. Mr. R. St. George-Moore, 17, Victoria Street, S.W.	Jan. 30
Ebbw Vale.—Construction of Carno reservoir (three contracts). Engineer, Mr. Geo. F. Deacon, 16, Great George Street, Westminster, S.W.	Jan. 31
Halifax.—Supply and erection of a coal conveyor, shutes, etc., for the Tramways and Electricity Committee. Mr. W. M. Rogerson, Borough Electrical Engineer, Foundry Street, Halifax	Jan. 31
Manuden.—Erection of an iron girder bridge at Common Mead, Manuden, Essex, for the Stanstead Rural District Council. Mr. Chas. Hicks, Surveyor, Stanstead, Essex	Feb. 1
Salford.—Supply and erection of steelwork, wrought and cast-ironwork, brickwork, masonry, etc., required in the reconstruction of two bridges for the Building and Bridges Committee. Engineers, Messrs. C. S. Allott and Son, 46, Brown Street, Manchester	Feb. 2

	Last Day
Handsworth. — Supply and delivery of power and lighting circuits and fittings for generating station (Contract 10), Pipework, Feed-pumps, Economiser (Contract 11), electricity meters (Contract 12). Mr. H. Ward, Clerk, Handsworth, Birmingham.	Feb. 2
Kirkcaldy.—An extension of about 500 ft. to present East Pier for the Town Council. Mr. Wm. L. Macendoc, Town Clerk ...	Feb. 4
Woking.—Supply and erection of steel gas-holder and steel tank for the Woking District Gas Company. Mr. B. Dennett Holroyd, Secretary, 5 and 6, Great Winchester Street, E.C.	Feb. 11
Nottingham.—Construction of reservoir at Wilton Hill. Mr. F. W. Davies, Water Engineer, Water Offices, St. Peter's Square	Feb. 13
South Shields. — Execution of works and supply of plant in connection with the construction of overhead electric tramways. Mr. J. Moore Hayton, Town Clerk.	Feb. 20
Brisbane.—Supply of steel rails and steel fishplates. Agent-General for Queensland 1, Victoria Street, S.W.	Mar. 7
Lulea (Sweden).—Widening and deepening of the Channel, "Tjufholssundet," at Lulea. Harbour Commissioners, Lulea, will supply particulars	April 1
Bermuda.—The Crown Agents for the Colonies are prepared, on behalf of the Government of Bermuda, to receive tenders for the deepening, widening and buoying of the channel leading from sea into St. George's Harbour, in the Islands of Bermuda. Particulars of Messrs. Coode, Son and Matthews. 9, Victoria Street, S.W. Tenders to Crown Agents for Colonies, Whitehall Gardens, S.W. ...	—

COMING CONTRACTS.

Anstruther.—The estimated cost of the harbour extensions has been increased to £36,704.

Natal.—The Natal Government Gazette publishes the text of a bill to authorise the construction of a tramway at Durban, with powers to generate electric current

Switzerland.—The Feuille Fédérale Suisse of Dec 28th, publishes a Decree authorising the Administration of the Federal Railways to construct a narrow-gauge line from Brienz to Interlaken, at an estimated cost of 5,500,000 fr. (about £220,000).

Austria-Hungary.—The Moniteur des Intérêts Matériels (Brussels) states that the Municipality of Vienna will shortly invite tenders for the execution of the following works: Extension of the tramway system, cost, 6,150,000 crowns (about £256,250); establishment of a second water system, cost, 2,900,000 crowns (about £120,833); construction of bridges, cost 900,0000 crowns (about £37,500); extension of electric light system, cost, 6,000,000 crowns (about £250,000).

Cape Town.—Extensive contracts for tramway plant, and equipment are foreshadowed under the scheme now under consideration for constructing an electric tramway from Cape Town, linking up the municipal areas of Woodstock and Maitland.

Admiralty.—The Admiralty have sent out invitations to a few English firms to submit tenders for the construction of five torpedo boats to be 165 ft. long and to have a speed of 25 knots.

Barrow-in-Furness. — The Local Government Board has sanctioned the borrowing by the Town Council of £35,000 for electric supply purposes.

Macclesfield.—The Town Council is applying for permission to borrow £15,000 for an electric supply scheme.

Barking.—Application is to be made for a loan of about £9,000 for electric supply extensions.

Maidstone.—The Corporation are raising £25,000, as authorised by the Maidstone Corporation Light Railways Order, 1903.

Upton-on-Severn.—The Council are applying for sanction to a loan of £6,000 for carrying out sewerage works.

Dover.—Works are to be put in hand at once in connection with the fall of cliff in St. Margaret's Bay, and with the view to preventing further coast erosion.

Yarmouth.—Application is to be made for a loan of £10,000 for new plant, including another 300-k.w. engine and dynamo and boilers at £4,500, and an additional water conduit, estimated to cost £3,500. The Corporation propose spending £56,000 on electric tramways.

Turin.—A sum of 40,000,000 francs is to be expended in improvements which include a powerful hydro-electric plant and a new aqueduct.

District Railway.—The Metropolitan District Railway Company in their new Bill seek for power to raise £400,000 towards the general purposes of the undertaking, the cost of adapting the railway for electrical working, etc.

CONTRACTS CLOSED.

Underground Electric Railways.—The Underground Electric Railways Company of London has placed an order with the Sir Hiram Maxim Electrical and Engineering Company, for a large number of "Maxim" direct-current traction circuit arc lamps.

Swansea.—The tender of the British Insulated and Helsby Cables, Ltd., for telephone cables and extensions to switchboard has been accepted by the Telephone Committee.

Canterbury.—The Council has accepted tenders from Dick Kerr and Co., Ltd., for 300 k.w. steam dynamo from Davey, Paxman and Co., for boiler and superheater, from J. G. Statter and Co., for switchboard, from E. Green and Sons, for extensions to economiser, and from E. J. Philpott for electric wiring.

West Ham.—The Corporation has accepted tenders from Babcock and Wilcox, Ltd., from Ferranti, Ltd., from the British Thomson-Houston Company, Ltd., and from Windsor and Co., for boiler work and electrical equipment.

Whitby.—The District Council has accepted the tender of C. A. Parsons and Co., for a 200-k.w. steam turbine at £1,550.

South Africa.—A steam crane to cost about £15,000 is being built by Messrs. Cowans Sheldon and Co. Ltd., of Carlisle, for shipment to South Africa.

Derby.—The tender of J. G. White and Co., Ltd., for tramway extension has been accepted at a price of £3,000

Glasgow. — The Mirrlees Watson Company Ltd., of Glasgow, have recently received orders for condensing plants from the following: British Thomson-Houston Company for County of London Electric Supply Corporation; Alfred Parry, Manchester, for Calcutta; Trafford Power and Limited Supply Company, Manchester, per Lacey Sillar and Leigh; J. and P. Coats, Ltd., for Barcelona, British Thomson-Houston Company for London; Crewe Electricity Works, Gwynnes Ltd., London.

APPOINTMENTS VACANT.

	Last Day.
Calcutta.—Assistant Engineer to the Port Commissioners. Salary Rs. 450 per month. Applications to the Commissioners' London agent, Mr. J. H. Apjohn, 17, Victoria Street, Westminster, S.W.	Jan. 24
Ripley.—Gas Works Manager. Applications to Secretary, Gas Works, Ripley, Derby...	Jan. 30
Luton.—Borough Engineer and Surveyor. Applications to Mr. G. Sell, Town Hall, Luton	Jan. 31
Battersea.—Borough Electrical Engineer. Salary, £400 per annum. Applications to Mr. W. Marcus Wilkins, Town Clerk, Lavender Hill, S.W....	Jan. 31
Sligo.—Harbour Engineer. Salary, £200 per annum. Applications to Mr. T. J. Mercer, Harbour Office, Sligo	Feb. 15
Manchester.—Professor of Engineering in Victoria University. Salary, £1,000 per annum. Applications to Registrar at the University	Feb. 15

APPOINTMENTS FILLED.

Liverpool.—Mr. S. W. Shakespear has been appointed at a salary of £700 per annum, to succeed Mr. G. B. Proctor as chief traffic manager to the Liverpool Dock Board, the latter having retired.

Macclesfield.—Mr. William Newbigging, of Manchester, has been appointed to the position of gas engineer to the Macclesfield Corporation, at a salary of £300 per annum.

Hindley.—Mr. Oswald P. Abbott, has been appointed engineer and surveyor to the Hindley (Lancs.) Urban District Council.

Johannesburg.—Mr. G. S. B. Andrews, deputy town engineer, has been appointed engineer at a salary of £1,800 per annum.

Exeter.—Mr. Hederstead has been appointed chief officer of tramways to the Exeter City Council at a salary of £400 a year. Mr. Hederstead has been in the service of the London County Council.

Millwall Dock Company.—The directors of the Millwall Dock Company have elected Mr. F. E. Duckham, M.Inst.C.E., to a seat on the board on his retirement from the position of general manager and engineer of the company, and have appointed Mr. W. S. T. Biggs and Mr. George Hazlehurst joint managers, these two gentlemen still retaining their present positions of secretary and superintendent respectively. Mr. Magnus Mowat, jun., late assistant engineer, has been appointed engineer to the company.

ELECTRIC LIGHTING AND POWER.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£135,000	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	102 —104
111,000	3	—	London Elec. Supply Corp., Ld., Ord.	3	2⅛ — 2⅜
60,000	5	3/-	Do. 6% Pref.	5	5 9/16— 5 13/16
£371,895	Stk	4%	Do. 4% 1st Mort.Db.Stk.,Red.	100	96 — 98
100,000	10	9/-	Metropolitan Elec. Sup. Co.,Ld.,Or.	10	18 — 18½
76,121	5	2/3	Do. 4½% Cum. Pref.	5	5 7/16—5 9/16
220,000	Stk	4½%	Do. 4½% 1st Mort.Db.Sk.,Red.	100	110 —115
250,000	Stk	3½%	Do. 3½% Mort. Deb. Stk, Red.	100	96 — 98
£250,000	—	4½%	Midland Elec. Corp. for Power Distribution. Ld., 4½% 1st Mort.Deb.	100	92 — 95
10,852	10	6/-	Notting Hill Elec. Ltg. Co. Ltd.Ord.	10	14½— 15
£59,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	102 —104
16,500	5	2/6	Oxford Electric Co. Ltd., Ord. ..	5	6⅛— 6⅜
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	98 —100*
£84,700	100	4½%	Royal Elec. Co. (of Montreal) 4½% 20-yr. 1st Mort.Deb	100	100 —102
40,000	5	5/-	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	13½— 14
20,000	5	3/6	Do. 7% Pref.	5	8½— 9
£150,000	Stk	3½%	Do. 3½% Deben. Stock, Red	100	98 —100
12,000	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2¾— 3¼
£50,000	Stk	4%	Do. 4% Debenture Stk Red.	100	83 — 87
65,000	5	3/-	South London Elec. Sup. Co.,Ltd.O.	5	4⅛— 4⅜
100,000	1	—	South Metropolitan Elec Light & Power Co., Ltd. Ord.	1	13/16 — 15/16
50,000	1	8⅔d.	Do. 7% Cum. Pref.	1	1⅜— 1 7/16
£100,000	Stk	4½%	Do. 4½% 1st Deb. Stock Red.	100	107 —110
50,000	5	2/6	Urban Electric Supply Co., Ltd., O.	5	5 — 5⅛
30,000	5	2/6	Do. 5% Cum Pref.	5	5 1/16 — 5 3/16
£200,000	Stk	—	Do. 4½% 1st Mort.Deb.Stk.Red	100	105 —107
110,000	5	6/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	12¾— 13¼
28,151	5	2/6	Do. 5% Cum. Pref.	5	6¼— 6¾

V.—TELEGRAPH & TELEPHONE COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£34,800	100	4%	African Direct Tel. Co., Ld., 4% Mt. Debs. (Series A), Red.	100	99 —102
25,000	10	—	Amazon Telegraph Co., Ld... ..	10	¾— 1¼
£763,580	Stk	12/6	Anglo-American Tel. Co., Ltd., Ord.	100	57 — 59
£3,118,210	Stk	25/-	Do. 6% Preferred Ordinary	100	103½—104½
£3,118,210	Stk	2/-	Do. Deferred Ordinary .	100	13— 13¼
44,000	5	3/-	Chili Telephone Co., Ltd.	5	6 — 6¼*
$15,000,000	$100	$2	Commercial Cable Co., Capital Stk.	$100	170 —190
£1,903,856	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	94 — 96
16,000	10	5/-	Cuba Submarine Tel. Co., Ld., Ord.	10	8¾— 9¼
6,000	10	10/-	Do. 10% Preference	10	16½— 17½
6,000	5	2/-	Direct Spanish Telegraph Co., Ord.	5	3⅛— 3⅜
		5/-	10% Cum. Preference	5	7¾— 8¼
£30,000	50	4½%	Do. 4½% Debs...	50	100-102%
60,710	20	3/-	Direct U.S. Cable Co., Ltd... ..	20	10⅜—10⅞*
£85,800	100	4½%	Direct West India Cable Co., Ltd., 4½% Reg. Debs.	100	99 —101
£300,000	100	4%	East. & S. African, Ld., 4% Mt. Db-.	100	101 —103
£200,000	25	4%	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)..	25	100-102%
300,000	10	2/6	Eastern Extension, Australasia and China, Ltd...	10	13½— 14*
£602,400	Stk	4%	Do. 4% Mort. Deb. Stk., Perp.	100	106 —108
£4,000,000	Stk	25/-	Eastern Tele. Co., Ltd., Ord. ..	100	134 —137*
£2,000,000	Stk	17/6	Do. 3 % Pref.	100	87 — 89*
£1,836,814	Stk	4%	Do. 4% Mort. Deb.	100	105 —107
150,000	10	5/-	Great Northern Telegraph Co., Ltd., (of Copenhagen) ..	10	29¼— 29¾
£58,700	100	4½%	Halifax and Bermudas Cable Co., Ltd., 4½% 1st. Mort. Debs. Red.	100	99 —101
17,000	25	12/6	Indo-European Tele. Co., Ltd. ..	25	45 — 47
72,680	1	7½d.	Monte Video Telephone Co.,Ltd.,O.	1	13/16— 15/16
£1,983,333	Stk	6%	National Telephone Co., Ltd., Pref.	100	108½—109½
£1,966 667	Stk	5%	Do. Deferred	100	106—108
15,000	10	6/-	Do. 6% Cum. 1st Pref. ..	10	13 — 15
15,000	10	6/-	Do. do. 2nd do. ..	10	12 — 13
250,000	5	2/6	Do. 5% Non-Cum. 3rd Pref.	5	5 5/16— 5 7/16
£2,000,000	Stk	3½%	Do. 3½% Deb. Stk., Red. ..	100	96 — 98
£689,593	Stk	4%	Do. 4% do. do. ..	100	101 —103
£1,0 0	—	5/9	Do. 4% Prov. Certs. all paid..	—	101 —103
179,313	1	7½d.	Oriental Telephone & Elec. Co.,Ltd.	1	1 — 1⅛
50,000	1	7½d.	Do. 6% Cum. Pref.	1	1⅛— 1¼
£100,000	100	4%	Pacific & European Tel. 4% Guar. Debs. Red...	100	96 — 99
11,839	8	4/-	Reuter's Telegram Co., Ltd. ..	8	7 — 7½
58,000	5	3/-	United River Plate Telep. Co., Ltd.	5	6½— 6¾
40,000	5	2/6	Do. 5% Cum. Pref.	5	5 — 5¼
£179,947	Stk	5%	Do. 5% Deb. Stock, Red. ..	100	104—106
15,609	10	4/-	W. African Telegraph Co., Ltd. ..	10	7¼— 7¾

TELEGRAPHS AND TELEPHONES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£30,008	2½	—	West Coast of America, Ltd. ..	2½	½— ⅝
150,000	100	4%	Do. 4% Deb. Guar. by West.Tel.	100	98 — 100
88,321	10	6d.	W.India&Panama Teleg.Co.,Ld.,Or.	10	⅝— ⅞
34,563	10	6/-	Do. 6% Cum. 1st. Pref. ..	10	7⅜— 7⅝
4,669	10	6/-	Do. 6% Cum. 2nd Pref. ..	10	6¾— 7¼
£80,000	100	5%	Do. 5% Deb.	100	101 —103
207,930	10	3/-	Western Telegraph Co., Ltd. ..	10	13½— 14
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	101 —103
518,915	Stk	4%	Do. 4% Deb. Stock, Red. ..	100	100 —102

VI.—SHIPPING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
32,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 5½% Cum. Pref.	10	8½— 9
£325,000	Stk	4½%	Do. 4½% Red. 1st Mort. Deb.Stk.	100	99 —101
£672,900	Stk	4½%	British & African Stm. Nav. (1900), Ltd., 4½% 1st Mort. Deb. Stk. Red.	100	91 — 93
40,000	10	5/6	Bucknall Steamship Lines, Ltd., 5½% Cum. Pref.	10	6 — 7
£600,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk.	100	73 — 76
£750,000	Stk	4½%	Clan Line Steamers, Ltd., 4½% Deb. Stk. Red. ..	100	98 —100
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000..	20	13 — 13½
40,000	20	8/-	Do. Nos. 60,001-100,000	10	5¾— 6¼
£451,430	Stk	4½%	Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. ..	100	100 —102
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord...	1	1 — 1⅛
30,000	10	5/-	Do. 5% Cum. Pref.	10	9¾— 10¼
327,300	100	4½%	Do. 4½% 1st Mort.Debs.Red.	100	105 —107
25,328	7½	4/7	Gen.Steam Navigation Co., Ld., Ord.	7½	4¼— 4¾
36,758	8	4/9⅗	Do. Non-Cum. 6% Pref.	8	7¼— 7¾
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	96 — 98
55,000	5	1/3	Houlder Line, Ltd., Ord.	5	3 — 3½
40,000	5	2/9	Do. 5½% Cum. Pref.	5	3¼— 3¾
£200,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk. Red.	100	83 — 86
141,500	10	5/-	Leyland (Fredk.), & Co. (1900), Ltd., 5% Cum. Pref. ..	10	5¼— 5¾
£1,160,000	Stk	5 %	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. ..	100	126 —129
£1,160,000	Stk	19%	Do. do. Deferred ..	100	216 —219
£800,000	Stk	3½%	Do. do. 3½% Deb. Stock ..	100	99 —101
£648,100	Stk	3½%	Do. do. 3½% 2nd Deb. Stk.	100	96 — 98
15,000	100	30/-	Royal Mail Steam Packet Co. Ord .	60	26 — 27
39,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref..	5	4¾— 5¼
39,075	5	2/6	Do. "B" Ord...	5	4 — 4½
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord..	10	8 — 8½
24,000	10	4/6	Do. 4½% Cum. Pref... ..	10	9½— 10
£1,008,894	Stk	4%	Do. 4% Debenture Stk.,Red.	100	99 —101

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
60 000	1	9⅗d.	Chadburn's (Ship) Tele. Ltd., Ord...	1	⅞— 1⅛
£750,000	Stk	5%	General Hydraulic Power Co., Ltd.	100	137 —142
12,500	10	10/-	Oakey (John) and Sons, Ltd., Ord..	10	24 — 26
10,000	10	6/-	Do. do. 6% Cum. Pf.	10	14 — 15
183,538	1	6·3d.	Power Gas Corp., Ltd., Ord., Nos. 66,463-250	15/-	5/16— 7/16
66,462	1	8·4d.	Do. do. Nos. 1 66,462	1	9/16— 11/16
135,000	1	6d.	Waygood (R.) & Co., Ltd., Ord. ..	1	1 1/16— 1 3/16
135,000	1	7½d.	Do. 6% Cum. Pref. ...	1	1⅛— 1¼*

RAILWAY CARRIAGE & WAGON COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices
10,000	10	7/6	Birm. Railway-Car, & Wagon, L., 1-10,000	10	21 — 21½
8,739	10	3/-	Do. Second Issue 1-8,739 ...	4	8¼— 8¾
10,000	10	6/-	Do. Cum. Pref. 6% 1-10,000..	10	13 — 13½
30,111	7	7/-	Gloucester Rail.-Car & Wagon, Ld., A, 1-29,861 & 49,751-50 000	7	8⅞— 9⅜
44,889	7	3/6	Do. B, 29,862-49,750, 50,001-75,000	7	4 — 4½
781,808	1	9d.	Metropolitan Amalgamated Rail.-Carriage & Wagon, Ld., 1-784,808	1	39/9— 40/3
164,288	1	6d.	Do. Cum. A Pref. 5% 1-164,288	1	23/6—24/6
235,000	1	7½d.	Do. Cum. B Pref. 6% 1-235,000	1	28/- —28/6
20,000	20	20/-	Midland Rail.-Car. & Wagon, Ld., 1-20,000	10	19 — 19½
10,000	20	7½d.	Do. Pref. 6 per cent. 1-10,000		22/3— 22/9

Stocks and Shares marked * are quoted ex-dividend.

II.—ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
70,000	1	6d.	Alliance Elec. Co., Ltd. 5% Cum. Pf.	1	⅝— ⅞
125,000	1	7½d.	Aron Elec. Meter Ltd., 6% Cum. Pf.	1	7/16— 9/16
120,000	1	9½d.	Bell's Asbestos Co., Ltd.	1	13/16— 15/16
100,000	5	4/-	British Insulated & Helsby Cables Ltd., Ord. ..	5	5 — 5¼
100,000	5	3/-	Do. 6% Cum. Pref.	5	5¼— 5¾
£500,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Rd.	100	101 —104
£200,000	Stk	4½%	British Thomson-Houston Co., Ltd.. 4½% 1st Mort. Deb. Stk. Red. ..	100	101 —103
400,000	5	3/-	British Westinghouse Electric and Manufac. Co., Ltd., 6% Pref. ..	5	2⅝— 2⅞
£616,358	Stk	4%	Do. 4% Mort. Deb. Stk. Red...	100	86 — 88
105,731	2	2/-	Brush Elec. Enging. Co., Ltd., Ord..	2	⅝— ⅞
150,000	2	2/4½	Do. 6% Pref.	2	1¼— 1½
£125,000	Stk	4½%	Do. 4½% Perp. 1st Deb. Stk...	100	93 — 96
£125,000	Stk	4½%	Do. 4½% Perp. 2nd Deb. Stk.	100	74 — 77
35,000	5	5/-	Callender's Cable & Constn. Ltd. Ord.	5	9 — 10
40,000	5	2/6	Do. 5 % Cum. Pref.	5	5 — 5½
£200,000	Stk	4½%	Do. 4½% 1st Mort. Deb Stk. Red.	100	104 —106
85,000	3	1/6	Crompton & Co., Ltd...	3	2 — 2¼
£100,000	—	5%	Do. 5% 1st Mort. Reg. Debs.	100	93 — 98
52,000	5	10/-	Dick, Kerr & Co., Ltd., Ord. ..	5	8 — 8½
61,000	5	3/-	Do. 6% Cum. Pref.	5	5¾— 6
£300 000	Stk	4½%	Do. 4½% Deb. Stock, Red. ..	100	105 —107
233,334	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	1⅛— 1⅜
£233,334	Stk	4%	Do. 1st Mort. 4% free. Deb. Stk.	100	105 —108
99,261	5	1/6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	3	⅝— ⅞
17,139	5	2/6	Do. "A" Shares Nos. 01-017.139	5	1 — 1½
£344,023	Stk	4%	Do. 4% Deb. Stock Red. ..	100	78 — 83
£100,000	Stk	5%	Do. 5% Second Deb. Stk. Red.	100	79 — 84
112,100	2	1/7½	Electric Construction Co., Ltd. ..	2	1⅛— 1¼
31,390	2	2/9⅝	Do. 7% Cumulative Pref. ..	2	2¼— 2½
£200,000	Stk	4%	Do. 4% Perp. 1st Mt. Deb. Stk.	100	97 — 99*
10,248	10	7/6	Evered and Co., Ltd...	10	13 — 15
£100,000	Stk	5%	Ferranti, Ltd., 5% 1st Mort. Deb. Stock, Red...	100	90 — 95
25,000	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9½— 10
£200,000	Stk	4%	Do. 4% 1st. Mt. Deb. Stk.. Red.	100	91 — 96
35,000	5	5/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	10¼— 10¾
35,000	5	2/3	Do. 4½% Cum. Pref... ..	5	5⅛— 5⅝
£50 000	Stk	4½%	Do. 4½% Mt. Deb. Stk. Red.	100	110 —112
50,000	10	5/-	India Rubber, Gutta Percha & Telegraph Works Co., Ltd.,	10	15 — 16*
£300,000	100	4%	Do. 1st Mort. Deb. Red. ..	100	99 —102
7,500	10	—	Parker, Thos., Ltd.	10	6½— 7
37,350	12	12/-	Telegraph Construction and Maintenance Co., Ltd.	12	38 — 40
£150,000	100	4%	Do. 4% Deb. Bonds	100	101½-103½

III.—ELECTRIC TRACTION.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
120,000	5	3/-	Anglo-Argentine Trams Co., Ld., Or.	5	8½— 8¾
260,007	5	2/6	Do. 5% Cum Pf.	5	5⅝— 5¾
£230,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888 ..	100	140 —143
20,000	10	6/-	Barcelona Trams Co., Ltd., Ord. ..	10	12 — 12½
10,000	10	5/-	Do. 5% Cum Pf. Shares	10	9 — 10
£46,300	100	5%	Do. 5% Debs., Red. ..	100	99 --102
£191,326	Stk	4½%	Do. 4½% Red. Deb. Stk.	100	95 —100
75,606	1	—	Bath Elec. Trams. Ld., Pf. Or. ..	1	⅝— ¾
59,394	1	11·49d	Do. 5% Cum. Pf. ..	1	⅞— 1
75,000	5	—	Brisbane Electric Tram Investment Co., Ltd., Ord... ..	5	1½— 2
75,000	5	2/6	Do. 5% Cum. Pf. ..	5	3¾— 4¼
£425,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	94 —98
£200,000	Stk	6%	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	100 —108
		5%	Pref. Ord. Stock	100	100 —103
7,500	10	5/-	Do. 5% Cum. Perp. Pf. ..	10	10 —10½*
£242,800	40	4½%	Do. 4½% 1st Mort. Debs. ..	40	102 ·104%
£220,000	100	4½%	Do. 4½% Vancouver Power Db.	100	97 —100*
133,301	10	6/-	Brit. Electric Traction, Ltd., Ord.	10	9½—10½
156,427	10	6/-	Do. 6% Cum. Pref... ..	10	11 — 11½
£1,000,000	Stk	5%	Do. 5% Perp. Deb. Stk. ..	100	118 —120
£250,000	Stk	4½%	Do. 4% 2nd Deb. Stk. Red..	100	97 — 99
100,000	5	1/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	4½— 4⅝
40,500	5	3/-	Do. "A" 6% Cum Pref. ..	5	5¾— 6
27,000	5	3/-	Do. "B" do.	5	5¼— 5½
£200,000	Stk	5%	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	94 — 97

ELECTRIC TRACTION.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	98 —101
102,268	5	3/-	Calcutta Tramways Co., Ltd. ..	5	8⅝— 9
£350,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	106 —108
480,000	1	6d.	Cape Electric Tramways, Ltd. ..	1	1⅛— 1¼
40,000	5	2/6	City of Birmingham Trams Co., Ltd. 5 % Cum. Pref.	5	4⅞— 5
£300,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	98 —102
155,000	5	4/-	City of Buenos Ayres Trams. Co., Ld.	5	10¼— 10
£116,000	Stk	6%	Do. Per. 6% Deb. Stk...	100	140 —145
£120,000	Stk	5%	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	101 —104
60,000	10	6/-	Dublin United Trams. Co. (1896), Ltd., Ord. ..	10	13 — 14
59,987	10	6/-	Do. 6% Pref...	10	15 — 16
80,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	3¾— 4
£150,000	Stk	4%	Do. 4% Deb. Stock.. ..	100	90 — 95
125.000	10	5/-	London United Trams. (1901), Ltd., 5% Cum. Pref.	10	10½—
£1.031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	103 —
£50,000	Stk	5%	Madras Electric Trams (1904), Ltd., 5% Deb Stock, Red.	100	101 —103
314,016	1	—	Metropolitan Elec. Trams, Ltd., Def.	1	—
500,000	1	6d.	Do. 5% Cum. Pref... ..	1	— 1
£350,000	Stk	4½%	Do. 4½% Deb. Stock, Red.	100	102 —104
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	— 1½
110,923	8	2/9¾	North Metropolitan Tramways Co..	8	4¾— 5
£150,000	100	3½%	Do. 3½% Mort. Debs.	100	90 — 95
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red..	100	101 —104
24,500	10	10/-	Potteries Elec. Traction Co., Ld., Or.	10	8 — 9
24,500	10	5/-	Do. 5% Cum. Pref. ..	10	8½— 9
£220,000	Stk	4½%	Do. 4½% Deb. Stk., Red.	100	99 —102

IV.—ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed.	Shares.	Last Dividend	Name.	Paid up.	Closing Prices.
7,500	10	16/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. ..	10	12 — 13
7,500	10	4/6	Do. 4½% Cum. Pref. ..	10	9½— 10
7,500	10	6/-	Do. 6% Cum. Second Pf. ..	10	11 — 12
£70,000	Stk	4½%	Do. 4½% Deb. Stock Red ..	100	102 —104
14,000	5	2/-	Bromley (Kent) Elec. Lt. & Pr. Co. Ld	5	5½— 5
£50,000	Stk	4½%	Do. do. 4½% 1st Deb. Stk. Red.	100	101 —104
27,507	5	4/6	Brompton & Kensington Elec. Supply Co., Ltd. Ord. ..	5	10½— 11
12,498	5	3/6	Do. 7% Cum. Pref. Shares..	5	10¼— 10
60,000	5	3/-	Calcutta Elec. Sup. Cor. Ltd., Ord..	5	8½— 8
£288,782	Stk	4%	Central Elec. Sup. Co., Ltd., 4% Gua. Deb. Stk. ..	100	105 — 10
70,000	5	4/-	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord... ..	5	8¼— 8
10,000	5	—	Do. do. Ord.	5	8 — 8
80,000	5	2/3	Do. do. 4½% Cum. Pref...	5	5 3/16— 5
£350,000	Stk	4%	Do. do. 4% Deb. Stk. Red.	100	101 —10
40,000	5	2/3	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	4⅞—5 1/16
40,000	5	2/3	Do. do. do. (1903) ..	5	4⅞—5 1/16
41,486	5	2/3	Chelsea Elec. Sply. Co., Ltd., Ord.	5	6⅝— 7
£150,000	Stk	4½%	Do. do. 4½% Deb. Stk., Red	100	108 —110
70,595	10	5/-	City of London El. Lghtg. Co., Ld., O.	10	11 — 11
40,000	10	6/-	Do. 6% Cum. Pref.	10	13½— 14
£400,000	Stk	5%	Do. 5% Deb. Stk., Red ..	100	121 —125
£300,000	Stk	4½%	Do. 4½% 2nd Deb. Stk., Red	100	101 —103
40,000	10	4/-	County of London Elec. Supply Co., Ltd., Ord.	10	9 — 9
30,000	10	6/-	Do. 6% Cum. Pref.	10	12 — 13
£400,000	Stk	4½%	Do. 4½% Deb. Stk., Red. ..	100	107 —110
£250,000	—	4½%	Do. 4½% 2nd Deb. Stk., Prv. Crts. all paid, Red	100	101 —103
70,000	5	2/6	Edmundson's Elec. Cor. Ltd., Ord.	5	6½ - 6
70,000	5	3/-	Do. 6% Cum. Pref.	5	6 — 6
£300,000	Stk	4½%	Do. 4½% 1st Mort. Db. Stk. Reg	100	106 —108
£80,000	Stk	5%	Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. Stk. Red.	100	86 — 91
10,000	5	2/-	Folkestone Elec. Supply Co., Ld., O.	5	5½— 6
£50,000	Stk.	4½%	Do. 4½% 1st Deb. Stk., Red.	100	102 —105
15,000	10	—	Havana Electricity Co., Ltd... ..	10	9½—10
18,000	5	3/6	Hove Elec. Lighting Co., Ltd., Ord.	5	7½— 8
£50,000	Stk	4½%	Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock, Red.	100	100—102
150,000	1	—	Kalgoorlie Electric Power & Lighting Corp., Ltd., 6% Cum. Pref.	1	⅝—
21,000	5	5/-	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord. ..	5	12½— 1

Stocks and Shares marked * are quoted ex-dividend.

ELECTRIC LIGHTING AND POWER.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£135,000	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	102 —104
111,000	3	—	London Elec. Supply Corp., Ld., Ord.	3	2⅛ — 2⅜
60,000	5	3/-	Do. 6% Pref.	5	5 9/16 — 5 13/16
£371,895	Stk	4%	Do. 4% 1st Mort. Db. Stk., Red.	100	95 — 98
100,000	10	9/-	Metropolitan Elec. Sup. Co., Ld., Or.	10	18 — 18½
76,121	5	2/3	Do. 4½% Cum. Pref.	5	5 7/16 — 5 9/16
220,000	Stk	4½%	Do. 4½% 1st Mort. Db. Sk., Red.	100	110 —115
250,000	Stk	3½%	Do. 3½% Mort. Deb. Stk, Red.	100	96 — 98
£250,000	—	4½%	Midland Elec. Corp. for Power Distribution, Ld., 4½% 1st Mort. Deb.	100	92 — 95
10,852	10	6/-	Notting Hill Elec. Ltg. Co. Ltd. Ord.	10	14½ — 15
£59,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	102 —104
16,500	5	2/6	Oxford Electric Co. Ltd., Ord. ..	5	6½ — 6⅝
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	98 —100*
£84,700	100	4½%	Royal Elec. Co. (of Montreal) 4½% 20-yr. 1st Mort. Deb	100	100 —102
40,000	5	5/-	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	13½ — 14
20,000	5	3/6	Do. 7% Pref.	5	8½ — 9
£150,000	Stk	3½%	Do. 3½% Deben. Stock, Red	100	98 —100
12,000	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2¾ — 3¼
£50,000	Stk	4%	Do. 4% Debenture Stk Red.	100	83 — 87
65,000	5	3/-	South London Elec. Sup. Co., Ltd. O.	5	4⅛ — 4⅜
100,000	1	—	South Metropolitan Elec Light & Power Co., Ltd. Ord.	1	13/16 — 15/16
50,000	1	8⅔d.	Do. 7% Cum. Pref.	1	1⅜ — 1 7/16
£100,000	Stk	4½%	Do. 4½% 1st Deb. Stock Red.	100	107 —110
50,000	5	2/6	Urban Electric Supply Co., Ltd., O.	5	5 — 5⅛
30,000	5	2/6	Do. 5% Cum Pref.	5	5 1/16 — 5 3/16
£200,000	Stk	—	Do. 4½% 1st Mort. Deb. Stk. Red	100	105 —107
110,000	5	6/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	12¾ — 13¼
28,151	5	2/6	Do. 5% Cum. Pref.	5	6¼ — 6¾

V.—TELEGRAPH & TELEPHONE COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£34,800	100	4%	African Direct Tel. Co., Ld., 4% Mt. Debs. (Series A), Red.	100	99 —102
25,000	10	—	Amazon Telegraph Co., Ld... ..	10	¾ — 1¼
£763,580	Stk	12/6	Anglo-American Tel. Co., Ltd., Ord.	100	57 — 59
£3,118,210	Stk	25/-	Do. 6% Preferred Ordinary	100	103½—104½
£3,118,210	Stk	2/-	Do. Deferred Ordinary .	100	13 — 13¼
44,000	5	3/-	Chili Telephone Co., Ltd.	5	6 — 6¼*
$15,000,000	$100	$2	Commercial Cable Co., Capital Stk.	$100	170 —190
£1,903,856	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	94 — 96
16,000	10	5/-	Cuba Submarine Tel. Co., Ld., Ord.	10	8¾ — 9¼
6,000	10	10/-	Do. 10% Preference	10	16½ — 17½
6,000	5	2/-	Direct Spanish Telegraph Co., Ord.	5	3¼ — 3⅝
		5/-	10% Cum. Preference	5	7¾ — 8¼
£30,000	50	4½%	Do. 4½% Debs...	50	100-102%
60,710	20	3/-	Direct U.S. Cable Co., Ltd... ..	20	10⅝—10⅞*
£85,800	100	4½%	Direct West India Cable Co., Ltd., 4½% Reg. Debs.	100	99 —101
£300,000	100	4%	East. & S. African, Ld., 4% Mt. Db-.	100	101 —103
£200,000	25	4%	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)..	25	100-102%
300,000	10	2/6	Eastern Extension, Australasia and China, Ltd...	10	13½ — 14*
£602,400	Stk	4%	Do. 4% Mort. Deb. Stk., Perp.	100	106 —108
£4,000,000	Stk	25/-	Eastern Tele. Co., Ltd., Ord. ..	100	134 —137*
£2,000,000	Stk	17/6	Do. 3 % Pref.	100	87 — 89*
£1,836,814	Stk	4%	Do. 4% Mort. Deb.	100	105 —107
150,000	10	5/-	Great Northern Telegraph Co., Ltd., (of Copenhagen) ..	10	29¼ — 29¾
£58,700	100	4½%	Halifax and Bermudas Cable Co., Ltd., 4½% 1st. Mort. Debs. Red.	100	99 —101
17,000	25	12/6	Indo-European Tele. Co., Ltd. ..	25	45 — 47
72,680	1	7½d.	Monte Video Telephone Co., Ltd., O.	1	13/16 — 15/16
£1,983,333	Stk	6%	National Telephone Co., Ltd., Pref.	100	108½—109½
£1,966 667	Stk	5%	Do. Deferred	100	106—108
15,000	10	6/-	Do. 6% Cum. 1st Pref. ..	10	13 — 15
15,000	10	6/-	Do. do. 2nd do. ..	10	12 — 13
250,000	5	2/6	Do. 5% Non-Cum. 3rd Pref.	5	5 5/16 — 5 7/16
£2,000,000	Stk	3½%	Do. 3½% Deb. Stk., Red. ..	100	96 — 98
£689,593	Stk	4%	Do. 4% do. do. ..	100	101 —103
£1,0 0	—	5/9	Do. 4% Prov. Certs. all paid..	—	101 —103
179,313	1	7½d.	Oriental Telephone & Elec. Co., Ltd.	1	1 — 1⅛
50,000	1	7½d.	Do. 6% Cum. Pref.	1	1⅛ — 1¼
£100,000	100	4%	Pacific & European Tel. 4% Guar. Debs. Red...	100	96 — 99
11,839	8	4/-	Reuter's Telegram Co., Ltd. ..	8	7 — 7½
58,000	5	3/-	United River Plate Telep. Co., Ltd.	5	6½ — 6¾
40,000	5	2/6	Do. 5% Cum. Pref.	5	5 — 5¼
£179,947	Stk	5%	Do. 5% Deb. Stock, Red. ..	100	104—106
15,609	10	4/-	W. African Telegraph Co., Ltd. ..	10	7¼ — 7¾

TELEGRAPHS AND TELEPHONES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£30,008	2½	—	West Coast of America, Ltd. ..	2½	½ — ⅝
150,000	100	4%	Do. 4% Deb. Guar. by West. Tel.	100	98 — 100
88,321	10	6d.	W. India & Panama Teleg. Co., Ld., Or.	10	⅝ — ¾
34,563	10	6/-	Do. 6% Cum. 1st. Pref. ..	10	7⅛ — 7⅜
4,669	10	6/-	Do. 6% Cum. 2nd Pref. ..	10	6¾ — 7¼
£80,000	100	5%	Do. 5% Deb.	100	101 —103
207,930	10	3/-	Western Telegraph Co., Ltd. ..	10	13½ — 14
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	101 —103
518,915	Stk	4%	Do. 4% Deb. Stock, Red. ..	100	100 —102

VI.—SHIPPING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
32,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 5½% Cum. Pref.	10	8½ — 9
£325,000	Stk	4½%	Do. 4½% Red. 1st Mort. Deb. Stk.	100	99 —101
£672,900	Stk	4½%	British & African Stm. Nav. (1900) Ltd., 4½% 1st Mort. Deb. Stk. Red.	100	91 — 93
40,000	10	5/6	Bucknall Steamship Lines, Ltd., 5½% Cum. Pref.	10	6 — 7
£600,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk.	100	73 — 76
£750,000	Stk	4½%	Clan Line Steamers, Ltd., 4½% Deb. Stk. Red. ..	100	98 —100
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000..	20	13 — 13½
40,000	20	8/-	Do. Nos. 60 001-100,000	10	5¾ — 6¼
£451,430	Stk	4½%	Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. ..	100	100 —102
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord...	1	1 — 1⅛
30,000	10	5/-	Do. 5% Cum. Pref.	10	9¾ — 10¼
327,300	100	4½%	Do. 4½% 1st Mort. Debs. Red.	100	105 —107
25,328	7½	4/7	Gen. Steam Navigation Co., Ld., Ord.	7½	4¼ — 4¾
36,758	8	4/9⅗	Do. Non-Cum. 6% Pref.	8	7¼ — 7¾
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	96 — 98
55,000	5	1/3	Houlder Line, Ltd., Ord.	5	3 — 3½
40,000	5	2/9	Do. 5½% Cum. Pref.	5	3¼ — 3¾
£200,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk. Red.	100	83 — 86
141,500	10	5/-	Leyland (Fredk.), & Co. (1900), Ltd., 5% Cum. Pref. ..	10	5¼ — 5¾
£1,160,000	Stk	5 %	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. ..	100	126 —129
£1,160,000	Stk	19%	Do. do. Deferred ..	100	216 —219
£800,000	Stk	3½%	Do. do. 3½% Deb. Stock ..	100	99 —101
£648,100	Stk	3½%	Do. do. 3½% 2nd Deb. Stk.	100	96 — 98
15,000	100	30/-	Royal Mail Steam Packet Co. Ord .	60	26 — 27
39,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref..	5	4¾ — 5¼
39,075	5	2/6	Do. "B" Ord...	5	4 — 4½
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord..	10	8 — 8½
24,000	10	4/6	Do. 4½% Cum. Pref... ..	10	9½ — 10
£1,008,894	Stk	4%	Do. 4% Debenture Stk., Red.	100	99 —101

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
60 000	1	9½d.	Chadburn's (Ship) Tele. Ltd., Ord...	1	⅞ — 1⅛
£750,000	Stk	5%	General Hydraulic Power Co., Ltd.	100	137 —142
12,500	10	10/-	Oakey (John) and Sons, Ltd., Ord..	10	24 — 26
10,000	10	6/-	Do. do. 6% Cum. Pf.	10	14 — 15
183,538	1	6·3d.	Power Gas Corp., Ltd., Ord., Nos. 66,463-250	15/-	5/16 — 7/16
66,462	1	8·4d.	Do. do. Nos. 1 66,462	1	9/16 — 11/16
135,000	1	6d.	Waygood (R.) & Co., Ltd., Ord. ..	1	1 1/16 — 1 3/16
135,000	1	7½d.	Do. 6% Cum. Pref. ...	1	1⅛ — 1¼*

RAILWAY CARRIAGE & WAGON COMPANIES.

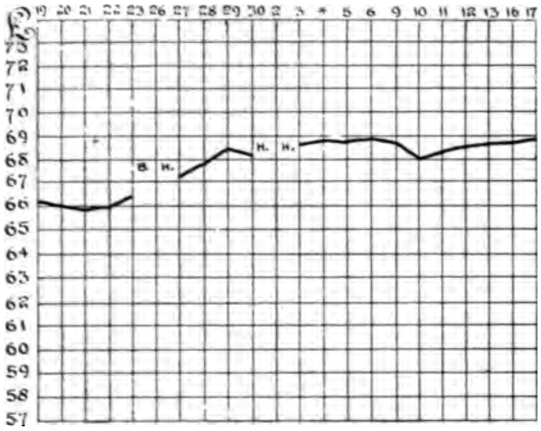
Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices
10,000	10	7/6	Birm. Railway-Car. & Wagon, L., 1-10,000	10	21 — 21½
8,739	10	3/-	Do. Second Issue 1-8,739 ...	4	8¼ — 8¾
10,000	10	6/-	Do. Cum. Pref. 6% 1-10,000..	10	13 — 13½
30,111	7	7/-	Gloucester Rail.-Car & Wagon, Ld., A, 1-29,861 & 49,751-50 000	7	8⅞ — 9⅜
44,889	7	3/6	Do. B, 29,862-49,750, 50,001-75,000	7	4 — 4½
784,808	1	9d.	Metropolitan Amalgamated Rail.-Carriage & Wagon, Ld., 1-784,808	1	39/9 — 40/3
164,288	1	6d.	Do. Cum. A Pref. 5% 1-164,288	1	23/6 — 24/6
235,000	1	7½d.	Do. Cum. B Pref. 6% 1-235,000	1	28/- — 28/6
20,000	20	20/-	Midland Rail.-Car. & Wagon, Ld., 1-20,000	10	19 — 19½
10,000	20	7½d.	Do. Pref. 6 per cent. 1-10,000		22/3 — 22/9

Stocks and Shares marked * are quoted ex-dividend.

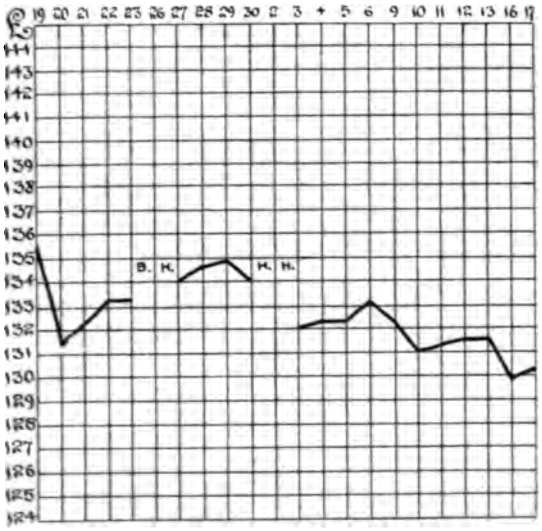
THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM DECEMBER 19TH, 1904, TO JANUARY 17TH, 1905.

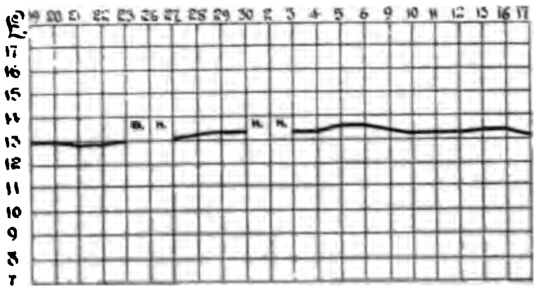
COPPER.



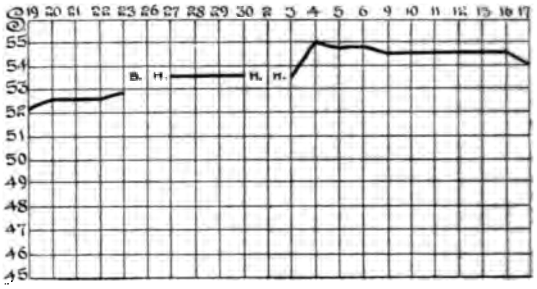
TIN.



ENGLISH LEAD.



PIG IRON: SCOTCH,



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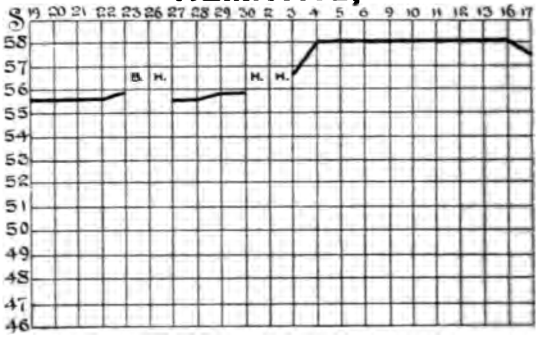
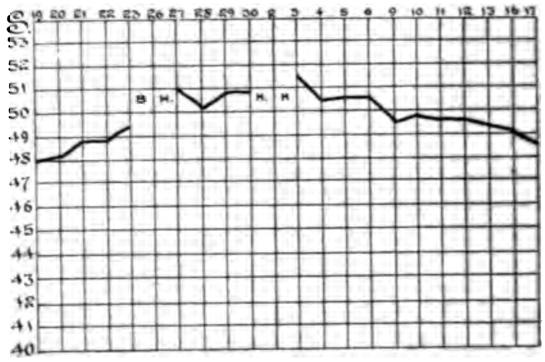
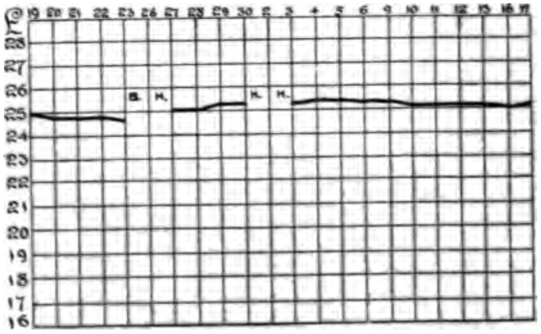


CLEVELAND.



SPELTER.



PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

MARKET REPORT.

Wednesday, January 18th, 1905.

THE Copper statistics for the middle of the month published on Monday reveal the nakedness of the position. The figures show that the amount of metal in sight is 1,148 tons lower at 15,586 tons, and it is difficult to see what is to prevent the market going higher. Messrs. Morrison, Kekewich and Co., who are not prone to taking extreme views, state that copper is in a dangerously strong position. Messrs. Merton and Co., point out that as producers are very well sold for the next month or two, they can look on indifferently and await further developments. The price closed yesterday at £69 5s. cash, and £69 7s. 6d. three months.

Tin is recovering from a fit of depression, when under the influence of large realisations and bear pressure prices at one time receded for cash to £131. There is however a distinct scarcity of supplies for prompt delivery, and with the coming Banca sale exercising its influence, the position of tin is sufficiently strong to suggest the belief that the market will see quotations higher in the immediate future. English closed yesterday at £131 10s.

The Iron and Steel market has shown some irregularity but the demand for pig iron remains steady, and with prospects of increasing business makers are showing an inclination to put additional furnaces in blast. The Glasgow market for pig-iron warrants has been firmer on good advices from the States, where stocks are being largely drawn upon, and on reports of shipbuilding orders for the Clyde.

Lead has been rather a dull spot, the large arrivals having kept prices at a low level, but there has been some recovery from a lowest quotation of £12 17s. 6d. The latest prices are Foreign, £13; English, £13 5s.

There is little fresh to record in connection with Spelter. Producers are so well sold that they have again raised their prices and quote only for distant delivery. Yesterdays quotation was £25 ordinaries, and a shade higher for specials.

The Coal market shows a tendency towards higher prices particularly in the case of steam descriptions, the the Admiralty requirements for the near future being of a heavy character. On the strike in Westphalia there is also good buying of second class coal.

IRON, STEEL, PIG-IRON, &c.

SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as follows. Prices delivered in Glasgow or equal :—

	£	s.	d.
Steel:			
Siemens' Steel Plates, Marine Boiler Quality	6	15	0
,, ,, ,, Land ,, ,,	6	17	6
,, ,, ,, Ship Quality Plates	5	17	6
Siemens' Steel Bars, Boiler Quality	6	17	6
,, ,, ,, Ship ,,	6	7	6
,, ,, Angles	5	7	6
Manufactured Iron:			
Bars—Dalzell	6	2	6
,, Best	6	12	6
,, ,, Horseshoe	6	12	6
,, Angle	6	2	6
,, Best Angle	6	12	6
,, Best Best	7	2	6
,, Extra Best	7	12	6

Usual terms and extras. Special rates for delivery in England and export. The above prices subject to alteration without notice.

The Glasgow Iron and Steel Co., Ltd., Wishaw, quote as under (prices are delivered Glasgow or equal) :—

	£	s.	d.	
Steel Angles (Glasgow ♛ Steel)	5	7	6	per ton.
Steel Ship Plates (Glasgow ♛ Steel)	5	17	6	,,
Steel Bars, Ship Quality (Glasgow ♛ Steel)	6	7	6	,,
Steel Bars, Boiler Quality (Glasgow ♛ ♛ Steel)	6	17	6	,,
Steel Land Boiler Plates (Glasgow ♛ ♛ Steel)	6	7	6	,,
Steel Marine Boiler Plates (Glasgow ♛ ♛ Steel)	6	7	6	,,

Less 5 per cent. discount. Extras as per standard list.

Special prices for delivery in England and for export. The above prices subject to alteration without notice.

John Spencer (Coatbridge), Ltd., Phœnix Ironworks, Coatbridge, N.B., quotes :—

	£	s.	d.
Bars—Phœnix	6	5	0
,, Best	6	15	0
,, Best Best	7	5	0
,, Extra Best	7	15	0
,, Best Horse Shoe	6	15	0
,, Extra B.H.S.	7	15	0
,, Extra Best Cable	8	5	0
,, Rivet	6	5	0
,, Best Scrap Rivet	7	5	0

	£	s.	d.
Angles—Phœnix	6	5	0
,, Best	6	15	0
,, Extra Best	7	5	0
Gas Tube Hoops—Phœnix Best	6	15	0
Plates—Phœnix	—		
,, Best Boiler	7	10	0
,, Best Best Boiler	8	0	0
,, Extra Best Boiler	9	0	0
Boiler Tube Strips—Phœnix Best Best	8	0	0

All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly.

Messrs. R. Feldtmann and Co., of Glasgow, quote Commission extra).

Pig Iron:

	No. 1. £	s.	d.	No. 3. £	s.	d.
Coltness, f.a.s. Glasgow	3	5	0	2	15	0
Gartsherrie ,,	2	19	6	2	14	6
Summerlee ,,	2	19	6	2	14	6
Carnbroe ,,	2	15	6	2	13	0
Langloan ,,	3	4	0	2	15	0
Calder ,,	2	19	0	2	14	6
Clyde ,,	2	19	0	2	14	6
Glengarnock, f.o.b. Ardrossan	2	19	0	2	13	6
Eglinton ,, ,,	2	15	0	2	13	0
Dalmellington, ,, Ayr	2	15	0	2	13	0
Shotts ,, Leith	2	19	0	2	14	6

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, **at works**:—

	£	s.	d.
W.W. ♔ Bars	6	12	6
W.W. Best Bars	7	2	6
W.W. Best Best	7	12	6
W.W. Best Best Best	8	2	6
W.W. Best Shoe	7	2	6
Thornaby ♔	8	2	6
Thornaby Best	8	12	6
Thornaby Best Best	9	12	6
Whitwell Special Admiralty Cable	10	5	0
Special Chain Iron	9	5	0
Tube and Nail Strips	6	15	0
W.W. ♔ Angle Iron	6	15	0
W.W. Best Angle Iron	7	5	0
Tee Iron, to 8-inches United	7	12	6

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington, quote:—

	Iron. £	s.	d.	Steel. £	s.	d.
Crown (BNF) Bars	6	10	0	7	0	0
,, ,, Angles	7	0	0	7	10	0
,, ,, Tees	7	10	0	8	0	0
,, (WIW) Hoops	7	0	0	7	10	0
,, ,, Sheets	7	10	0	8	0	0

Ordinary Sizes, F.A.S. Liverpool in 10-ton lots.
Extras for Sizes and Cutting as per List.

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

Black Sheets:	Singles 20 G 96in. by 36in. per ton. £	s.	d.	Doubles 21 G to 24 G 96in. by 36in. per ton. £	s.	d.
"Vale"	10	0	0	10	10	0
"Shield"	10	10	0	11	10	0
"Severn"	11	10	0	12	10	0
"Baldwin Wilden B."	12	10	0	13	10	0
Charcoal	16	10	0	17	10	0
Best Charcoal	18	10	0	19	10	0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:	£	s.	d.	£	s.	d.
No. 3 Lead	13	10	0	14	10	0
S.V. Lead	15	0	0	16	0	0
No. 3 Terne	15	0	0	16	0	0
S.V. Terne	16	10	0	17	10	0

Tinned Sheets:	Singles 20 G to 108 by 36in. per ton. £	s.	d.	Doubles 21 to 24 G to 96 by 36in. per ton. £	s.	d.
Best Coke (Finish)	28	0	0	29	10	0
,, Charcoal (Finish)	30	0	0	31	10	0
Extra ,, ,,	32	0	0	33	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.
Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box.
Extreme sizes in Tin and Patent Coated specially quoted for.
Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.
At works less 2½% for cash monthly, 10th inst.

Galvanized Corrugated Sheets:

	£	s.	d.	
"Phœnix" Brand, 24 G., f.o.b. London, in Bundles	11	15	0	per ton.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	14	7	6	,,

Galvanized Working Up-Sheets:

	£	s.	d.	
24 G., f.o.b. London, in Bundles	13	15	0	per ton.

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£	s.	d.	
Crown Bars	6	10	0	per ton.
Best Bars (1 to 6in. wide, above ½ in. thick, ½ in. to 4 rounds and squares)	7	0	0	,,
Angles	6	15	0	,,
,, Best	7	5	0	,,
T's	7	0	0	,,
,, Best	7	10	0	,,
Best Shoe Iron	8	0	0	,,
,, Rivet Iron	8	0	0	,,
,, Best Rivet (Special)	9	5	0	,,
,, Cable	9	5	0	,,
,, Screwing	8	5	0	,,

	£	s.	d.	
Best Turning	8	0	0	per ton.
,, Plating	8	5	0	,,
,, ,, Best Best	9	5	0	,,
,, ,, Treble	10	5	0	,,
Plates	7	10	0	,,
Best Plates	8	0	0	,,
,, Boiler Plates	8	10	0	,,
,, Best Boiler Plates	9	10	0	,,
Treble Best Boiler Plates	12	0	0	,,

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon., quote "Star" brand patent wrought nails, steel nails, &c.

Discounts—

45 per cent. off 1-inch to 3-inch strong rose and all fine rose and 6dy. and 8dy. pound.

40 per cent. off 3½ inch to 7-inch strong rose and 10dy. and 20dy. pound.

40 per cent. off all sharp-pointed nails.

Delivered in lots of 4 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis:—

2 tons 9/3 per cwt.
4 cwt. lots and upwards 9/6 per cwt. } d/d any Railway Station.

Steel cut nails, 3-inch basis—

2 tons 8/- per cwt.
4 cwt. lots 8/3 per cwt. } d/d any Railway Station.

Slit rods (iron) £7 10s. per ton, at works for 2-ton lots.

Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E. C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla, quote:—

	Per Box. f.o.b. Wales. £	s.	d.
Coke Tin-plates.			
C 18¾ by 14 124s. 110 lb. "BV"	0	13	0
C 20 by 10 225s. 155 ,, "Jumbo"	0	18	3
C 20 by 14 112s. 108 ,, "Lydbrook"	0	12	6
C 28 by 20 112s. 216 ,, "Lydbrook"	1	5	3
Charcoal Tinplates:			
C 20 by 14 112s. 108 lb. "Allaway"	0	13	3

BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes:—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

	£	s.	d	
Steel:				
Blooms	at 3	12	0	per ton.
Billets	at 3	14	0	,,
Sheet Bars	at 3	16	0	,,
Finished Steel:				
Bars	at 4	17	6	per ton.
Angles	at 4	18	6	,,
Tees	at 5	0	0	,,
Joists	at 4	10	0	,,
Fencing Standards	at 5	1	0	,,
Shoeing Bars	at 5	2	0	,,
Tyre Bars	at 5	4	0	,,
Half-Round Bars	at 5	5	0	,,
Heavy Rails	at 4	10	0	,,
Light Rails	at 4	17	6	,,

Structural Steelwork:

Prices on application.

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote:—

TIN.

Tin:	£	s.	d.		£	s.	d.	
English Ingots, f.o.b. Dis. 1¼% & 1%	131	0	0	to	131	10	0	per ton.
English Bars, f.o.b. Dis. 1¼% & 1%	132	0	0	to	132	10	0	,,
Straits G.M.B., cash Warehouse, Net	130	0	0	to	130	5	0	,,
Straits G.M.B., 3 months, Warehouse, Net	130	7	6	to	130	10	0	,,
Australian, Mr. Bischoff, Warehouse, Net	130	15	0	to	131	0	0	,,

COPPER.

Copper:	£	s.	d.		£	s.	d.	
Standard G.M.B., cash Warehouse, Net	69	0	0	to	69	2	6	per ton.
Standard G.M.B., 3 months, Warehouse, Net	69	7	6	to	69	10	0	,,
English, Tough, Cake & Ingot, Warehouses, Net	71	0	0	to	71	10	0	,,
English, Best Select, Warehouse Net	72	0	0	to	72	10	0	,,
English, Sheets and Sheathing, f.o.b., Dis. 2½%	79	0	0	to	80	0	0	,,
English, Sheets for India, f.o.b., Dis. 2½%	76	0	0	to	76	10	0	,,
Electro, Warehouse, Net	70	0	0	to	70	5	0	,,
Ore, ex. ship	0	12	0	to	0	13	0	per unit.
Regulus, Matte and Precipitate, ex. ship,	0	13	3	to	0	14	0	,,

YELLOW METAL.

Yellow Metal:	£	s.	d.	£	s.	d.	
Sheets, 4 by 4 feet for India f.o.b. Dis. 2½%				0	0	6¾	per lb.
Sheathing ,, ,,				0	0	6⅞	,,

SPELTER:

	£	s.	d.		£	s.	d.	
Silesian outports, Net	24	15	0	to	25	0	0	per ton.
Blende of 50 % Net	7	0	0	to	7	10	0	,,
Calamine, Net	7	2	6	to	7	12	6	,,

LEAD.

	£	s.	d.		£	s.	d.	
English Pig, Warehouse, Dis. 2½%	13	5	0	to	13	7	6	per ton.
Spanish, ex ship, Dis. 2½%	13	0	0	to	13	2	6	,,
Lead Ore of 70 %, Net	6	12	6	to	6	15	0	,,

ANTIMONY.

	£	s.	d.		£	s.	d.	
Star Regulus, f.o.b., Dis. 2½ %	36	10	0	to	37	0	0	per ton.
Ore, 50 %, ex ship, Dis. 2½%	8	0	0	to	9	0	0	,,
Crude, ex ship, Dis. 2½ %	13	10	0	to	14	0	0	,,

QUICKSILVER.

	£	s.	d.	
Spanish, 75 lb., Warehouse, Net	7	15	0	per flask.
Italian ,, ,, ,,	7	14	0	,,

COAL.

LEICESTERSHIRE.

The Nailstone Colliery Company, Leicester, quote. Price per Ton at Pit of 20 Cwt., with ½ Cwt. per Ton for wastage —

Upper Main Seam.	s.	d.
Main Coal	7	6
Best Hard Steam (hand picked, as used by the Railway Companies)	6	0
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)	6	0
Fine Slack	0	6

Terms, net cash on 10th of month following delivery.

DERBYSHIRE.

The Manners Colliery Co., Ltd., of Ilkeston quote as follows, per ton at pit:

Kilburn Coal:	s.	d.
Best London Brights	9	9
Large Nuts (1½ to 3½)	9	6
Small Nuts (¾ to 1½)	6	0
Rough Brights	6	0
Peas (⅜ to ¾)	5	0
Slack	3	6
Smudge	2	0

Low Main (or Tupton) Coal:		
Low Main Brights	7	6
,, ,, Nuts	7	3
Hards (Good Steam Coal)	8	0
Bakers' Nuts (1" to 2")	6	6
Slack	3	6

The Clay Cross Company's Collieries, Clay Cross, near Chesterfield, quote:—

	per ton at pit. s.	d.
Best Main Coal	10	6
Best Silkstone	10	0
Best House Coal	8	6
Best House Nuts	8	0
Treble Screened Cobbles	7	9
Best Cobbles	7	3

NOTTINGHAMSHIRE.

The Digby Colliery Co., Ltd., near Nottingham, quote per ton at pit:—

Digby Coal:

STEAM.	s.	d.
Best Hand Picked Hard	9	0
Steam Hard	7	9
Hard Nuts	7	0

Gedling Colliery.

HIGH HAZEL.		
London Brights, 4 to 8 in. cube	12	0
Large Nuts, 2 to 4 in. cube	9	6
Small Nuts, ¾ to 2 in. cube	5	6

STEAM.—TOP HARD.		
Best Hard	9	0
Hard Steam	8	0
Cobbles	7	0

CHEMICALS AND OILS.

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square, Manchester, quote:

	£	s.	d.	
Acids: Oxalic	0	0	2⅛	per lb.
Picric, Crystals	0	0	11	,,
Tartaric ... at Manchester	0	0	10⅜	,,

	£	s.	d.	
Acetate of Lime: Brown at Manchester net	8	5	0	per ton.
Grey ,,	11	0	0	,,
Alumina: Alum, Lump, loose	5	5	0	,,
,, ,, in casks	5	7	6	,,
,, Ground, in bags	5	15	0	,,
Sulphate of Alumina, 14%	4	10	0	,,
Ammonia: Carbonate	0	0	3⅝	per lb.
Muriate Grey f.o.b. Liverpool	24	0	0	per ton.
Sal-ammoniac, Lump, 1sts, deld. U.K.	42	0	0	,,
,, ,, 2nds, ,,	40	0	0	,,
Sulphate ... f.o.b. Liverpool	12	15	0	,,
Arsenic: Best White Powdered ... net	12	0	0	,,
Bleaching Powder, 35% ... ,,	4	10	0	,,
Borax: British Refined Crystal ... ,,	12	0	0	,,

Coal Tar Products:	£	s.	d.	
Benzole, 50/90% ... ,,	0	0	8	per gal.
,, 90% ... ,,	0	0	9½	,,
Carbolic Acid Crystals, 34/35° C. ... ,,	0	0	6⅞	per lb.
,, ,, ,, 39/40° C. ... ,,	0	0	7⅛	,,
,, ,, Liquid, 97/99% ... ,,	0	0	9	per gal.
,, ,, Crude, 62½% at 60° F. f.o.b. ,,	0	2	0	,,
Creosote, ordinary good liquid ... ,,	0	0	1¼	,,
Naphtha, Crude, 20% at 120° C. ... ,,	0	0	3	,,
,, Solvent, 90% at 160° C. f.o.b ,,	0	0	8½	,,
,, ,, 95% at 160° C. ,, ,,	0	0	9½	,,
,, ,, 90% at 190° C. ,, ,,	0	0	10½	,,
,, Rectified, flash point over 73° F. ... f.o.b. ,,	0	0	11	,,
,, Rectified, flash point over 100° F. ... f.o.b. ,,	0	1	0	,,
Naphthalene, all qualities.				
Pitch ... f.a.s. Manchester. ,,	1	12	6	per ton.
Copperas: Green, in bulk ... ,,	0	12	6	,,
,, barrels f.o.b. L'pool ,,	1	19	0	,,
Cake ... ,,	1	2	6	,,
Copper: Sulphate	23	0	0	,,
Cyanides: 98% minimum ... f.o.b. net	0	0	8	per lb.
Lead: Acetate (Sugar) White. English	27	10	0	per ton.
,, ,, ,, Foreign c.i.f. U.K	24	5	0	,,
,, ,, Grey	21	15	0	,,
,, ,, Brown at Manchester	16	10	0	,,
Nitrate	24	0	0	,,
Litharge, Flake	15	10	0	,,
,, Powder	16	0	0	,,
Red Lead, Genuine, c.i.f. London less 5%	15	10	0	,,
White ,, ,, Dry ,, ,, ,,	16	15	0	,,
Naphtha (Wood): Miscible, 60 o.p.	0	2	10	per gal.
Solvent	0	2	7	,,
Potash: Bichromate ... delivered England ...	0	0	3	per lb.
Carbonate, 90/92% ... c.i.f Hull ...	18	0	0	per ton.
Caustic, 75/80% ... ,, ,, ...	20	10	0	,,
Chlorate ... net	0	0	3$\frac{1}{16}$	per lb.
Montreal ... in Store, Liverpool	35	0	0	per ton.
Prussiate, Yellow ... net	0	0	4$\frac{11}{16}$	per lb.

	£	s.	d.	
Soda: Ash, Caustic, 48 %, Ordinary ... ,,	5	5	0	per ton.
,, ,, ,, Refined...... ,,	6	5	0	,,
,, Carbonated, 48 %........... ,,	5	10	0	,,
,, ,, 58 % (Ammonia Alkali) ....net	4	10	0	,,
,, Bleachers' Refined Caustic 50/52 % .... net	6	10	0	,,
Caustic, White, 77 %.............. ,,	10	10	0	,,
,, ,, 70 %.............. ,,	9	12	6	,,
,, ,, 60 %.. .... ,,	8	12	6	,,
,, Cream, 60 %..... ....,	8	10	0	,,
Crystals, in bags	3	0	0	,,
,, barrels	3	7	6	,,
Acetate .... c.i.f. Hull net	16	10	0	,,
Bicarbonate, in 1 cwt. kegs............	6	15	0	,,
Bichromate......delivered England...	0	0	2¼	per lb.
Chlorate .... net	0	0	$3\frac{1}{16}$	per lb.
Nitrate...ex quay Liverpool, ... ,,	11	0	0	per ton.
Phosphate	9	5	0	,,
Prussiate ....net	0	0	3⅝	per lb.
Silicate, Solution, 140° Tw.	4	10	0	per ton.
Sulphate (Glauber Salts)...............	1	12	6	,,
,, (Saltcake, 95%)...............	1	15	0	,,
Sulphur: Recovered	4	15	0	,,
Roll	6	15	0	,,
Flowers....................................	7	10	0	,,
Zinc: Sulphate	6	15	0	,,

MINERALS.

	£	s.	d.	
Barytes: Lump Carbonate, 90/92%	3	10	0	per ton.
Sulphate, No. 1, White	2	15	0	,,
China Clay: of various qualities for all purposes; prices from about 11/- to about 30/- per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid.				
Chrome Ore: Basis 50% c.i.f. British Ports..........	3	7	6	,,
Manganese: Lump c.i.f. Liverpool 10¼d.	per metallic unit.			
Ochre: French JC .... f.o.b. Rouen, net	2	5	0	per ton.
,, JF	5	10	0	,,
Talc: (French Chalk).........c.i.f. Liverpool	3	10	0	,,

OILS, etc.

	£	s.	d.	
Aniline Oil ....net	0	0	4¾	per lb.
,, **Salt**.......... .... ,,	0	0	4½	,,
Castor Oil: French, 1st pressure, f.o.b. Marseilles less 1½%.........	20	10	0	per ton.
English, 1st pressure, f.o.r. Hull, less 2½%..............	22	0	0	,,
Cocoa Nut Oil: Ceylon, ex store Manchester..............net	30	0	0	,,
Cochin, ex store Manchester . ...net	32	0	0	,,
Cotton Seed Oil: Refined at Hull, less 2½% naked	12	17	6	,,
Edible...at Hull, less 2½% naked	13	7	6	,,
Glycerine: Crude, 80% .... net	31	0	0	,,
Linseed Oil: Raw... ..at Hull, less 2½% naked	12	12	6	,,
Boiled......at Hull less 2½% naked	13	12	6	,,
Starch: American Pearl...at Manchester, net	9	0	0	,,
Dextrine........... ,, ,,	18	0	0	,,
Farina............... ,, ,,	15	15	0	,,
Shellac: Standard TN orange spot	155/-			per cwt.
Turpentine: American.........at Liverpool	38	10	0	per ton.
Russian ....at Hull...net	18	10	0	,,

TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote:—

COLONIAL WOODS.

Timber.

		£	s.	d.		£	s.	d.
Quebec Square White Pine...	per cub. ft.	0	1	9	to	0	3	0
Quebec Waney Board Pine...	,,	0	2	8		0	3	9
St. John Pine, 18 in. average	,,	0	2	3		0	3	3
Lower Ports Pine...............	,,	0	1	3		0	1	8
Quebec Red Pine	,,	0	1	6		0	2	0
Quebec Oak, 1st quality	,,	0	2	9		0	3	3
Quebec Oak, 2nd quality ...	,,	0	1	6		0	2	6
Ash	,,	0	1	6		0	2	3
Elm	,,	0	3	0		0	3	9
Hickory	,,	0	2	0		0	2	6
Quebec Birch	,,	0	1	6		0	2	3
St. John Birch	,,	0	1	6		0	2	0
Birch Planks.....................	,,	0	0	9		0	0	11
Spruce Spars	,,	0	0	10		0	1	0

Deals.

		£	s.	d.		£	s.	d.
1st quality Quebec Pine	per std.	22	10	0	to	32	10	0
2nd do. do.	,,	17	0	0		22	0	0
3rd do. do	,,	11	10	0		13	0	0
St. John, N.B., etc., Spruce	,,	6	10	0		6	15	0
Lower Ports Spruce..	,,	6	0	0		6	10	0
Spruce Boards.................	,,	5	10	0		6	0	0

UNITED STATES, etc., WOODS.

Pitch Pine.

		£	s.	d.		£	s.	d.
Hewn	per cub. ft.	0	1	3	to	0	1	8
Sawn	,,	0	0	10		0	1	6
Planks, Stowage	,,	0	0	10		0	1	0
Boards, Prime	per std.	12	10	0		16	0	0
Oak Timber	per cub. ft.	0	1	6		0	2	6
Oak Planks	,,	0	1	6		0	2	1
East India Teak..............	per load	12	0	0		15	0	0
Greenheart.....	,,	6	15	0		7	10	0

EUROPEAN WOODS.

Timber.

		£	s.	d.		£	s.	d.
Riga Redwood	per cub. ft.	0	1	9	to	0	2	3
Dantzic and Memel Fir, Crown	,,	0	2	1		0	2	6
Dantzic and Memel Fir, Middling	,,	0	1	9		0	1	11
Stettin	,,	0	1	9		0	1	11
Swedish........................ ...	,,	0	1	2		0	1	4
Riga Whitewood	,,	0	1	3		0	1	6
Norway Mining Timber	,,	0	0	9		0	0	10
Dantzic and Stettin, etc., Oak..	,,	0	2	6		0	3	0
Norway Spars.................	,,	0	1	2		0	1	9

Deals.

		£	s.	d.		£	s.	d.
Red Archangel and Onega, 1st quality	per std.	19	0	0		21	0	0
Red Archangel and Onega, 2nd quality	,,	16	0	0		17	0	0
Red Archangel and Onega, 3rd quality	,,	12	10	0		15	0	0
St. Petersburg, 1st quality...	,,	16	0	0		17	10	0
Do. 2nd ,, ...	,,	14	0	0		15	0	0
Gefle	,,	14	0	0		17	10	0
Wyburg	,,	12	0	0		13	10	0
Uleaborg	,,	12	0	0		13	10	0
Gothenburg	,,	14	0	0		17	10	0

SELECTED PATENTS.

Compiled expressly for this journal by **Messrs. Page and Rowlingson, Engineering Patent Agents, 28, New Bridge Street, London, E.C.,** and at Manchester.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton Buildings, Chancery Lane, W.C., at the uniform price of 8d.

NEW PATENTS APPLIED FOR.

When Patents have been communicated the names of the communicators are printed in italics.

28,773. F. J. Cole and C. J. Mellin, London. Dec. 29th.—Improvement in steam boiler superheaters.

28,799. F. Hodgkinson, London. Dec. 29th.—Improvements in or relating to fluid pressure turbines. (Date applied for, Jan. 20th, 1904.)

28,803. H. Lenz., London. Dec. 29th.—Improvements relatable to variable velocity steam or gas turbines. (Date applied for, Aug. 5th, 1904.)

28,807. F. Jottrand, London. Dec. 29th.—A new or improved method or apparatus for cutting pipes, plates, and other metal articles.

28,810. E. Langheinrich, London. Dec. 29th.—Improvements in pumps.

28,893. D. R. Todd, Glasgow. Dec. 30th.—Improvements in water-tube boilers.

28,894. S. Couper and J. S. Millar, Glasgow. Dec. 30th.—An improved superheater for steam.

28,907. C. G. Day, Manchester. Dec. 30th.—Improvements in steam traps.

28,921. C. Wamser, Germany. Dec. 30th.—Improved appliance for automatically closing the smoke slide on opening the fire door of steam boiler furnaces.

28,924. A. Brake, London. Dec. 30th.—Improvements in apparatus for heating water. (*Mauri Bros. and Thomson, New South Wales.*)

28,941. A. Clark, Glasgow. Dec. 30th.—Rotary engine or turbine.

28,957. N. Vicente, London. Dec. 30th.—Improvements in and connected with distributing valves of steam engines.

28,972. Sir. J. I. Thorneycroft, London. Dec. 30th.—Improvements in water-tube boilers.

29,978. J. E. Evans-Jackson, London. Dec. 30th.—Improvement in turbine pumps. (*Turbine Pump Company, U.S.A.*)

29,031. E. Edwards, London. Dec. 30th.—Improvements in oil or gas engines.

29,032. G. Harris, London. Dec. 30th. Improvements in agricultural machinery.

29,060. L. Renault, London. Dec. 30th.—Improvements in connection with toothed operating gear for valves. (Date applied for July 16th 1904.)

29,090. J. Fleischmann, London. Dec. 30th.—Improvements in or relating to automatic cocks or valves.

29,102. A. A. W. van Reede, London. Dec. 30th.—Improvements in safety valves.

29,105. R. H. Davis and Siebe, Gorman and Co., Ltd., London. Dec. 30th.—Improvements in air pumps.

29,134. C. F. de Kierskowski-Steuart, London. Dec. 30th.—Improvements in and relating to steam generators.

29,171. W. J. Greaves, London. Dec. 30th.—Improvements in the flues of the boilers of steam generators and in the arrangement of water-tubes therein.

29,173. P. Kestner, London.—Dec. 31st.—Improvements in steam traps applicable also to automatic valves for regulating the flow of liquids.

29,230. E. W. Robey, and A. Rink, London. Dec. 31st.—Improvements in automatic draught regulating apparatus for steam boilers and other furnaces.

29,232. J. C. Merryweather and C. J. W. Jakeman. London. Dec. 31st.—Improvements in steam engines.

29,280. J. W. Cloud, London. Dec. 31st.—Improvements relating to marine propulsion.

29,318. F. L. Croft, T. A. Perkins and F. Croft, Bradford. Dec. 31st.—Improvements in or relating to the bearing of shafting and the supports therefor.

29,391. P. Mickelheit, London. Dec. 31st.—Improvements relating to separators for removing oil from steam.

29,399. A. Bagshawe, London. Dec. 31st.—Improvements in or connected with lift hoists or elevators.

29,426. D. B. Morison, London. Dec. 31st.—Improvements in apparatus for cleansing steam and heating water.

29,451. W. E. Evans, London. Dec. 31st.—Improvements relating to steam heating apparatus. (*C. H. Martini, Germany.*)

29,536. J. W. C. Prochnow, Kingston-on-Thames. Dec. 31st.—Improved gauge cock for steam boilers.

29,548. N. Foley, London. Dec. 31st.—Improvements in and relating to steam traps.

29,559. T. Downie, Liverpool. Dec. 31st.—Improvements in or connected with steam generators and other furnaces.

29,560. T. Reading and A. J. Houghton, Liverpool. Dec. 31st.—Improvements in pistons and piston valves and their packings.

29,563. J. Butterworth and Lancaster and Tonge, Ltd., Manchester. Dec. 31st.—Improvements in piston and like rings.

29,574. P. Dawson, Glasgow. Dec. 31st.—A combined induced draught and smoke annihilating appliance for ships.

29,596. E. Bennis, Manchester. Dec. 31st.—Improvements in furnaces for steam generators and other purposes.

29,597. E. Bennis, Manchester. Dec. 31st.—Improvements in furnaces for steam generators and other purposes.

29,629. H. Scharbau, Manchester. Dec. 31st.—Improvements in multiple steam or gas turbines.

29,651. H. Cruse, Manchester. Dec. 31st.—Improvements in water-tube boilers.

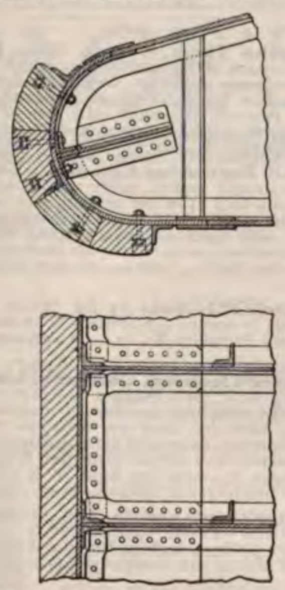
29,654. G. Johnston, Glasgow. Dec. 31st.—Improvements in connecting rods.

RECENT SPECIFICATIONS.

DOCK GATES.

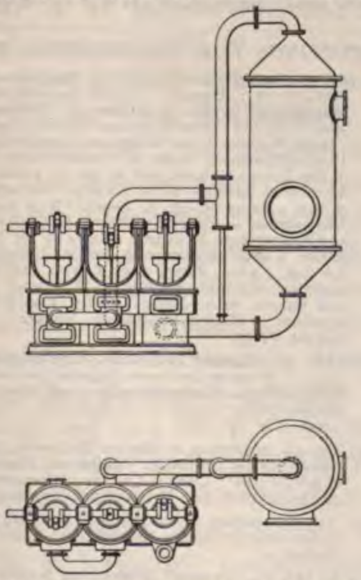
Sir W. G. Armstrong, Whitworth and Co., Ltd., and Roger Wright, of Newcastle-on-Tyne. Feb 12. 1904.—Dock gates as at present usually constructed are provided with a heel-post, consisting of an approximately semi-circular baulk of timber constituting the pivot about which the gate turns and forming a water-tight joint between the edge of the gate and the abutment. To obviate the disadvantages of this form of gate, especially in the larger sized gates, this invention describes a gate in which the heel post is entirely dispensed with, the edge of the gate itself being made of an approximately semi-circular form and being faced with timber. The construction is preferably as follows: The gate is as usual a hollow structure built up of metal plates stiffened with horizontal ribs. At the side of the gate next the abutment these plates are, according to this invention, bent into the arc of a circle of such a radius as to give ample bearing surface.

The curved side of the gate is stiffened by horizontal plates or ribs fixed to the ribs forming the side and projecting radially inwards and by vertical radial gusset plates fixed between each pair of such ribs. The outer curved surface of the edge of the gate is faced with stave-shaped baulks of timber bolted to it and prevented from moving tangentially by vertical angle pieces which also further stiffen the curved edge of the gate.



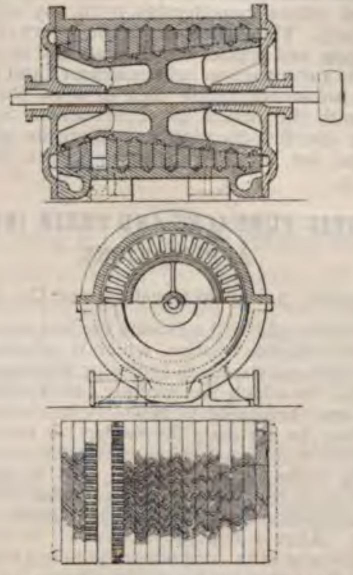
STEAM CONDENSERS.

C. Day and W. A. Dexter of The Mirrlees Watson Company, Ltd., of Glasgow. Nov. 5., 1904—This invention consists of an improvement in the method of dealing with the air and water in a jet condenser, that is to say, a condenser in which the steam and water mix. The arrangement consists of a combination of a wet air pump, that is to say, a pump designed to deal with both air and water, with a pump of the dry air type. The former pump will deal with the whole of the water of condensation and the condensing water, together with a portion of the air, and the latter pump will deal with the remaining portion of the air but none of the water, the wet air pump being designed of such capacity that even when dealing with the maximum amount of water it will also be dealing with a portion of the air.



TURBINES.

E. T. Pollard, London. Sept. 11, 1903.—This invention relates to fluid pressure turbines, and has for its object to provide a turbine in which the expansive energy of the steam or other elastic fluid is utilised to the utmost and in distinct successive stages, and to provide a turbine of inexpensive construction. It relates to turbines constituted of a series of movable rings alternating with a series of stationary rings, in which respective rings corresponding ports are provided of such a disposition, that the steam or other elastic fluid is guided from the ports in the stationary rings to act upon the ports in the moving rings. The ports in the respective rings are so arranged that in three consecutive rings they are never in communication at one time, so that the steam in the port of any moving ring cannot escape into a port of the next moving ring until communication with the port of the preceding moving ring is cut off. By such means the steam has an abutment against such stationary ring on which it can re-act. Preferably the number of ports in the first ring is exceeded by the number in the next ring, the number of ports being successively increased in the respective rings, so that the steam or other elastic fluid which operates with full pressure upon the ports in the first movable ring shall operate at reduced pressure through a successively greater number of ports in the succeeding rings.



CALENDARS AND DIARIES.

We have received from the Whitman and Barnes Manufacturing Company, an attractive wall calendar, the upper part of which is a picture by Mr. W. Watson, representing a group of sheep on a mountain side. We are reminded that the firm's European sales agent is Mr. Theodore Butler, of 149, Queen Victoria-street, E.C.

A handy pocket diary has been issued by the Clay Cross Company, of Clay Cross, near Chesterfield. Ample space is afforded for entries, and a good deal of useful information is given regarding the firm's economiser, gas and water pipes, cast-iron tanks, columns, and castings, etc.

A highly artistic wall calendar reaches us from the Yost Typewriter Company. The design is reproduced from a plaster model, a medallion bearing an excellent reproduction of the Yost machine.

A no less interesting calendar is that forwarded by the Leadenhall Press. This is executed on parchment paper with portrait of the Right Hon. J. Elizabeth Viscountess Andover.

NEW PUBLICATIONS.

"THE FAN:"

Including the Theory and Practice of Centrifugal and Axial Fans. By Charles H. Innes, M.A. Technical Publishing Company, Ltd., Manchester. 4s. net.

Those responsible for the efficient working and the designing of fans would do well to make themselves acquainted with Mr. Innes profusely illustrated volume. The work differs considerably from any other book on this subject. The writer adopts the theory of the centrifugal pump and applies it to the fan, and in the chapters devoted to a comparison between theory and experiment, he gives some interesting data to show that his theory agrees with the results of experiments. Specially interesting are the descriptions which are given of the centrifugal fan, the Rateau high-pressure fan, and the Screw fan.

"ELECTRIC FURNACES AND THEIR INDUSTRIAL APPLICATIONS."

By J. Wright. Archibald Constable and Co., Ltd. 8s. 6d.

The metallurgist will welcome the appearance of this singularly complete treatise, which is calculated to make an admirable companion to Professor Moissan's "Le Four Electrique," to which we recently called attention. The volume now before us is probably less exclusive in its scope than the former: the writer has embodied in his work a deal of information quoted from sources not easily accessible to the average student. Mr. Wright's volume presents, in a concrete form, a complete record of the many applications of the electric furnace in modern industry. After a concise account of its evolution, the writer discusses the arc furnace, pointing out the advantages of three-phase currents for electric furnaces of this type; attention is paid next to resistance furnaces, typical processes, and calcium carbide manufacture. An important section of the work deals with iron and steel production in the electric furnace, details of the various processes are given, and a number of authoritative statements from metallurgists of recognised standing are included. Other chapters are devoted to the manufacture of phosphorus and glass by means of this furnace; electrolytic furnaces and processes; miscellaneous electric furnace processes; laboratory furnaces and experimental research; tube furnaces; terminal connections and electrodes; efficiency and theoretical considerations, and the measurement of furnace temperatures. The illustrations are all that can be desired from a technical standpoint, representing constructional details rather than actual views of the objects.

"YEAR BOOK OF THE SCIENTIFIC AND LEARNED SOCIETIES OF GREAT BRITAIN AND IRELAND."

A record of the work done in science, literature and art during the session 1903-1904 by numerous Societies and Government Institutions. Compiled from official sources. Charles Griffin and Co., Ltd. 7s. 6d.

This indispensable annual has now reached its twenty-first year of publication, and its pages bear ample evidence of full maturity. The brief, but accurate, chronicle of the transactions of the various societies during the above year should prove of incalculable value to anyone engaged upon scientific research.

NEW CATALOGUES.

From Mr. John Thom, of Canal Works, Patricroft, we have received a catalogue of Boring Plants in which are described and illustrated, Percussion and Hand Boring Plants, Smith's Tools Steel Lining Tubes for Boreholes, Borehole Pumps, Diamond Boring Plants, etc. Profusely illustrated catalogues of Steam Valves and Fittings, Water Raising Appliances, and Waterworks Appliances are also to hand from this firm.

The Horsfall Destructor Company, Ltd., of Leeds and London, have issued a booklet, neatly and strongly bound in green linen, on Destructors. The first few pages of this publication are devoted to a list of "Horsfall" Patent Destructors at work or under construction; after which the system is briefly described. The bulk of the book however consists of full-page illustrations of Destructors erected in various districts, with suitable descriptions on the opposite pages.

Pamphlet No. 177 issued by the British Thomson-Houston Company, Ltd., is devoted to Rheostatic Controllers and Resistances and supersedes Pamphlet No. 91. It includes several half-tone illustrations.

The Lahmeyer Electrical Company, Ltd., of 109-111, New Oxford Street, W.C., have issued a four-page leaflet (Description No. 28), dealing with their new small three-phase motors, type D and Ds. We learn that these new motors are fitted with improved patent ball bearings, as recently illustrated and described in PAGE'S WEEKLY, manufactured by the Deutschen Waffen- und Munitionsfabriken, Berlin, by means of which it is claimed that the oil consumption and frictional losses are greatly reduced.

Messrs. J. Hopkinson and Co., Ltd., Huddersfield. List No. 240 describes the firm's Patent "Centre-Pressure" Valve, a new form of stop valve for turbines, engines, boilers and pipes. This pamphlet, which is well printed and arranged, contains several diagrams and tables.

Messrs. W. F. Dixon and Co., of 63, Percival Street, Manchester, forward circulars calling attention to their Improved Metal Bushed Raw-Hide Gear Wheels for silent driving.

A pictorial publication illustrating Shop Divisions as constructed by The New Expanded Metal Company, Ltd., of Stranton Works, West Hartlepool, has been issued by this firm. It includes some excellent half-tone blocks printed in sepia toned ink, showing interior views of different works in which divisions manufactured from this expanded metal have been erected. Amongst others we notice views of the machine shop and ground floor at the works of the British Westinghouse Electric and Manufacturing Company, Ltd., and interior views of the works of the Lancashire Dynamo and Motor Company, Ltd. We have also received illustrated leaflets dealing with other uses for the metal, such as letter-sorting racks, gates, etc.

MEETINGS FOR THE ENSUING WEEK.

FRIDAY, JAN. 20—Institution of Mechanical Engineers: Storey's Gate, S.W., 8 p.m.: Papers — "Some Impressions of American Workshops," by Mr. A. J. Gimson; "Waterworks Pumping Engines in the United States and Canada," by Mr. John Barr; "Some Features in the Design and Construction of American Planing Machines," by Mr. Archibald Kenrick, Jun.; "Engines at the Power Stations, and at the St. Louis Exhibiton," by Mr. Alfred Saxon.—Royal Society: Burlington House, W., 9 p.m.: Paper by Sir J. Dewar "New Low Temperature Phenomena."—North-East Coast Institution of Engineers and Shipbuilders, Newcastle: Paper by Mr. J. Little, "Petrol Motor Cars," Engineering Society: University College, London, 5 p.m.; Paper, "Arc Lamps and Methods of Arc Lighting.—Institute of Marine Engineers: Conversazione and Dance, Great Eastern Hotel, Liverpool Street, E.C., 6.30 p.m.—Electric Harmonic Smoker: Holborn Restaurant, 8 p.m.

SATURDAY, JAN. 21 — Glasgow Technical College Scientific Society, 7.30 p.m.: "Notes on Toolroom Organisation and Practice," Mr. George Blair.—Staffordshire Iron and Steel Institute "The Stirling Boiler," by Mr. C. E. Parbolton: Royal Institution, 3 p.m.

MONDAY, JAN. 23—Institution of Marine Engineers, Stratford, 8 p.m.: "Economy by Insulation." Adjourned discussion.—Society of Arts, 8 p.m.: Cantor Lecture; "Reservoir Stylographic and Fountain Pens," Mr. James P. Maginnis.

TUESDAY, JAN. 24.—Society of Arts, Colonial Section 4.30 p.m. "British Commercial Prospects in the Far East," by Mr. Byron Brenan.

WEDNESDAY, JAN. 25.—Liverpool Engineering Society.—"Design and Work of Pressing, Stamping, Forging and Similar Machinery." Mr. F. W. Steele—Society of Arts, 8 p.m. "London Electric Railways," Hon. Robert P. Porter.

FRIDAY, JAN. 27th.—Engineering Society: University College, London, 5 p.m.: Paper, "The Barrage of the Thames," by Mr. B. B. Willcox.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

VOL. VI. LONDON, FRIDAY, JANUARY 27, 1905. No. 20.

The Offices of "Page's Weekly," Wednesday, Midnight.

THE autumn meeting of the Iron and Steel Institute, fixed as usual for the last week in September, will be anticipated with enthusiasm both by the inhabitants of Sheffield and by the English and foreign visitors to that city. The following gentlemen will form an executive committee for the visit: The Lord Mayor (Alderman J. Jonas), the Master Cutler (Mr. George Hall), Mr. R. A. Hadfield (President), Colonel Hughes, Mr. H. H. Bedford (President of the Chamber of Commerce), Mr. W. F. Beardshaw, Mr. W. H. Ellis, Mr. S. J. Robinson, Mr. F. C. Fairholme, Mr. R. Colver, Mr. Ambrose Firth, Mr. T. W. Ward, Mr. John Rodgers, Mr. H. Steel, jun., Mr. Charles Allen, Alderman G. Senior, Mr. Woodward (Edgar Allen and Co.), Mr. S. Osborn, Mr. A. Jack, Mr. T. Wilkinson, Mr. Cosmo John (Vickers, Sons, and Maxim), Mr. A. J. Hobson, Mr. E. S. Howell, Mr. A. Balfour, Mr. R. Smith, Colonel Stoddart (Mayor of Rotherham), Mr. Maurice Deacon, Mr. Potts (J. H. Andrew and Co.), Mr. B. G. Wood, Mr. C. Siddall, Mr. Herbert Barber, Mr. J. H. Barber (Brown, Bayley and Co.), Principal Hicks, Mr. H. Westlake (Staveley Iron Co.), Mr. Lewis Firth, and Mr. M. J. Hunter. It is hoped that the new University College buildings will be available for the meeting. In view of the presidency of Mr. R. A. Hadfield, Sheffield offers a particularly happy venue, and we shall look forward to a record meeting.

The following is a list of the autumn meetings of the Institute since its formation in 1869: 1869 Middlesbrough-on-Tees; 1870 Merthyr Tydvil; 1871 Dudley; 1872 Glasgow; 1873 Liége; 1874 Barrow-in-Furness; 1875 Manchester; 1876 Leeds; 1877 Newcastle-on-Tyne; 1878 Paris; 1879 Liverpool; 1880 Düsseldorf; 1881 London; 1882 Vienna; 1883 Middlesbrough-on-Tees; 1884 Chester; 1885 Glasgow;

MR. ALLISON SMITH.

Recently appointed under the Colonial Office Locomotive Superintendent of the Gold Coast Railways.

1886 London; 1887 Manchester; 1888 Edinburgh; 1889 Paris; 1890 New York; 1891 London; 1892 Liverpool; 1893 Darlington; 1894 Brussels; 1895 Birmingham; 1896 Bilbao; 1897 Cardiff; 1898 Stockholm; 1899 Manchester; 1900 Paris; 1901 Glasgow; 1902 Düsseldorf; 1903 Barrow-in-Furness; 1904 New York.

In the course of their annual report the council of the Leeds Chamber of Commerce state that they have for a long time past felt the importance of the development of the canal system of this country. That this is so much behind the systems of other countries is due partly to the larger navigable rivers possessed by other countries, for, whilst this country has some 4,500 miles of navigation, the United States has nearly 20,000. Germany some 16,000, Russia 20,000, and France 8,000, and all these countries are spending immense sums in the improvement of their canal systems. We are again reminded that, excluding navigable rivers and ship canals, there are some 4,000 miles of inland waterways in this country ,of which about 30 per cent. are railway-owned, the remaining 70 per cent. being free from railway control. As showing the difference between these two classes of canals, it is mentioned that about 15 per cent. only, or an average of 5,000 tons per mile, pass over railway-controlled canals, whilst 85 per cent., or an average of 12.000 tons per mile. pass over free canals. But it is pointed out that the great defect of our canal system is the difference in gauge of locks and navigable depth between the different canals connected. One useful aim would be to suggest means for the amalgamation of the through waterways, and for carrying out works with the view of securing uniform gauge of locks and navigable depth. As an instance of what may be done in this direction, it is stated that a junction canal of some five and three-quarter miles in length has recently been made connecting the Aire and Calder Navigation with the Sheffield and South Yorkshire Navigation, and this short length has been made of such width and depth as to allow boats of the Aire and Calder type to pass thereover.

The Panama Canal is likely to be a very costly undertaking for the United States Government, and the time of its building will probably be equal to that of a generation, if present estimates are correct. Mr. J. F. Wallace, the chief engineer, of the Isthmian Canal Commission, has reported that a sea-level waterway across the isthmus, although it would cost far more and take much longer to complete than the three other canal projects under consideration, would in the end be the best. In his opinion, the cost of the sea-level canal would be $300,000,000, as against $200,000,000 for a 90-ft. level canal, and he thinks that twenty years would elapse before its completion, or ten years more than for a canal with locks.

Few readers, even if not directly interested in Patent regulations, can have perused the correspondence on this subject which has been appearing in the recent issues of PAGE'S WEEKLY without arriving at the conclusion that further legislation is imperatively needed. if justice is to be done to the inherent inventiveness of the British as a nation. It is unnecessary to sum up the correspondence here, as this is ably done in the present and preceding issue by Mr. B. H. Thwaite. It is hoped that the opinions stated will be of material assistance to those who are called upon to strike a just balance between the claims of the inventor and those of the general public. Among the points brought out by the discussion is the superiority of American Patent regulations. The Americans from the beginning seem to have realised the extraordinary importance of sound Patent legislation.

The first United States Patent Law of April, 1790, only followed in a general way the law at that time in existence in England, authorising the grant of patents without an examination of the prior art, and it is interesting to note the care with which those responsible for the granting of patents set about their duties. Mr. Jefferson, who was at that time Secretary of State, made the Patent Laws a subject of anxious solicitude, and regarded the granting of a patent as a matter of the greatest importance; in fact, he is generally referred to as the Father of the United States Patent Laws. When the application for a patent was made under the first Act, he would summon Mr. Henry Knox, of Massachusetts, who was Secretary of War, and Mr. Edmund Randolph, of Virginia, who was Attorney-General (these officers being designated by the Act, with the Secretary of State, a tribunal to examine and grant patents), and these three distinguished officials would examine the applications critically, scrutinise each point of the specification and claims carefully and rigorously. The result of this examination was that during the first year, a majority of the applications filed failed to pass the ordeal, and only three patents were granted. In those days every step in the issuance of a patent was taken with great caution, Mr. Jefferson seeking always to impress upon the minds of his officers and the public that the granting of a patent was a matter of no ordinary importance.

Captain Lionel James, although maintaining that the value and possibilities of wireless telegraphy in conjunction with journalistic enterprise has been amply demonstrated in the far East, is emphatically of opinion that all wireless communications during future military and naval operations will be controlled by international law. It will be remembered that the system employed on board the *Haimum* was that of Dr. de Forest, and it was chosen owing to its successful work in the field of American press rivalry during the yacht races of 1903. It is significant that within a radius of 200 miles of the scene of operations in the Yellow Sea, "countless" other wireless stations were at work on no less than four different systems. The fact that none of these other systems or stations interfered in the smallest degree with the Times messages did not fail to impress Captain James with the merits of the de Forest system. But how far his operations interfered with the other systems he is of course unable to say. The service was suspended, because the Japanese authorities recognised that the existence of the possible leakage of military secrets presented a flaw in their plan of campaign. Apart from this, a continuance of this enormously expensive service would have been fatal to the operators, for the Russians had threatened them with the death penalty and the Yellow Sea was literally alive with floating mines.

The new issue of Lloyd's Register states that during 1904, exclusive of warships, 712 vessels of 1,205,162 tons gross (viz., 613 steamers of 1,171,375 tons and 99 sailing vessels of 33,787 tons) have been launched in the United Kingdom. The warships launced at both Government and private yards, amount to 37 of 127,175 tons displacement. The total output of the United Kingdom for the year has, therefore been 749 vessels of 1,332,337 tons. This output of mercantile tonnage shows the slight increase of about 15,000 tons on that of last year, and, with the exception of 1903, is the lowest since 1897. Compared with the returns for 1901, when the output of both mercantile and war tonnage reached the highest level, the present figures show a reduction of 320,000 tons as regards merchant vessels, and 84,794 tons as regards war vessels. Of the tonnage launched 99·71 per cent. has been built of steel, 17 per cent. of iron, and 12 per cent. of wood. Steam tonnage is accountable for 97·2 per cent.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

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New Copy for Advertisements,

Alterations, &c., intended for insertion in the current week's issue must be delivered **not later than 4 p.m. on Monday.** If proofs are required the copy and blocks should reach us several days earlier.

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NEWS ITEMS.

Royal Coal Commission.

As we go to press the Final Report of the Royal Commission on Coal Supplies (Part I., General Report) comes to hand. Following the precedent of the Coal Commission of 1871, the limit of practicable depth in working has been set at 4,000 ft., and the minimum workable thickness at 1 ft. The available quantity of coal in the proved coal fields of the United Kingdom is estimated at

100,914,668,167 tons.

Of the available coal, no less than 79·3 per cent. is contained in seams of 2 ft. thick, and upwards. In addition to the coal within 4,000 ft. of the surface there are in the proved coalfields considerable quantities lying at greater depths. Whether this coal is recoverable or not depends of course upon the maximum depth at which it may be found possible to carry on mining operations. The estimated quantity of this coal is

5,236,433,980 tons.

The geological committee, appointed to inquire into the productive measures known or believed to exist outside the areas dealt with by the district commissioners, report that the amount of coal which may be expected to be available in the concealed and unproved coalfields at depths less than 4,000 ft. is

39,843,000,000 tons.

The present annual output is in round numbers 230,000,000 tons.

Almost all the opinions given to the Commission on the general question of coal cutting machines compared with hand labour are in favour of the former, but these opinions are accompanied by many qualifications and exceptions. Other possible economies are suggested, and the evidence shows that seams which cannot now be worked at a profit will in future be rendered profitable by washing, sorting, coking, and briquetting the coal, or converting it into gas, so that no small coal need be left in the mine. With this and other aspects of this important report we hope to deal with in our next issue.

* * *

It is announced that Marconi's Wireless Telegraph Company, Ltd., has entered into an agreement with the Oceanic Steam Navigation Company, Ltd. (the White Star Line) for the equipment of six of the White Star Line vessels—the *Oceanic*, *Celtic*, *Baltic*, *Cedric*, *Majestic* and *Teutonic*—with Marconi wireless apparatus.

British Standard Pipe Flanges.

We have just received from Mr. Leslie S. Robertson (secretary) the latest report of the Engineering Standards Committee, dealing with "Pipe Flanges." The publication is one which can scarcely fail to interest a large section of the engineering world, and as will be seen from table IV., reproduced herewith, it is drawn up in great detail. As regards classification of pressures, the committee recommend that flanges, etc., should be standardised in four classes, as follows: (1) Low-pressure standard, for steam pressures up to 55 lb., and water pressures up to 200 lb. per square inch; (2) intermediate-pressure standard, for steam pressures over 55 lb., but not exceeding 125 lb. per square inch; (3) high-pressure standard, for steam pressures over 125 lb., but not exceeding 225 lb. per square inch; (4) extra high-pressure standard, for steam pressures over 225 lb., but not exceeding 325 lb. per square inch.

It was decided that the number of bolts used should in all cases be a multiple of four, and that the bolt-holes should be so placed that spaces between them are bisected by the main centre lines. The Committee are quite aware that in the case of flanges for certain sizes of pipes—and especially of those for 2½-in. pipes—the adoption of multiples of four for the number of bolts involves some change of practice; but, after carefully discussing the opinions and experimental data brought before them, they are convinced that the advantages resulting from the adoption of such a principle outweigh the disadvantages.

For determining the sizes of bolts, it has been assumed that, in the case of a joint just on the point of leaking, the full working pressure might be exerted over the area of a circle just touching the inner sides of the bolt-holes, and the sectional area of the bolts at the bottom of the threads has been fixed to meet this contingency. In the case of the smaller sizes of pipes, allowances have also been made for undue stresses in making the joints. It is considered desirable that all nuts should be chamfered on the side bearing on the flange, and that the bearing surfaces of the heads, nuts, and flanges should be trued.

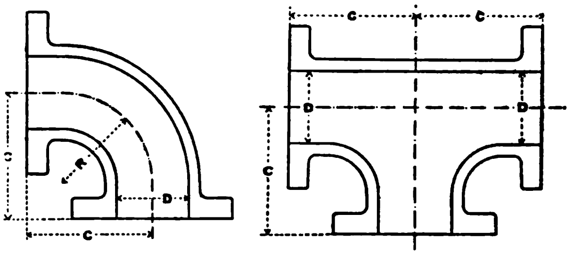
The sizes of bolt-holes decided upon were: For ½-in. and ⅝-in. bolts the diameter of the holes to be $\frac{1}{16}$ in. larger than the diameters of the bolts; and for larger sizes of bolts, ⅛ in.

Practically the sizes of flanges are governed by the necessity of adopting such diameters as will meet the requirements of makers of stop-valves and similar fittings. The diameters decided upon by the Committee are the smallest which will satisfy these.

Tables I. and II. deal with the dimensions of the British standard pipe flanges for the different pressures specified above. Table III. shows the dimensions of British standard welded-on flanges for pipe lines for working steam pressures up to 125 lb., 225 lb., and 325 lb. per square inch. Table IV. gives the dimensions of British standard short bends and tees of cast metal for all pressures up to 325 lb. per square inch, and table V. the dimensions of British standard long bends of wrought iron and steel.

The Committee on Pipe Flanges was as follows: Mr. William H. Maw (chairman); Mr. W. E. Smith, C.B., and Engineer-Commander A. R. Emdin, R.N., representing the Admiralty; Messrs. E. B. Ellington, Henry Davey, W. H. Patchell, Andrew Laing, John Steven, J. Dewrance, R. E. Atkinson, T. Hurry Riches, Frank Herbert, J. Hopkinson, Robert Hopkinson, T. Harris Spencer, and G. Watson.

TABLE IV.—DIMENSIONS OF BRITISH STANDARD SHORT BENDS AND TEES OF CAST METAL, FOR ALL PRESSURES UP TO 325 LB. PER SQUARE INCH.



These Sketches are merely for the purpose of identifying the dimensions given in the Table, and are not to scale.

D	C = D + 3 ins.	R	D	C = D + 3 ins.	R
Internal Diameter of Pipe.	Centre to Flange Face.	Radius of Centre-line of Bend.	Internal Diameter of Pipe.	Centre to Flange Face.	Radius of Centre-line of Bend.
ins. ½	ins. 3½	ins. 2½	ins. 9	ins. 12	ins. 9
¾	3¾	2¾	10	13	10
1	4	2¾	*11	14	10¾
1¼	4¼	3	12	15	11¾
1½	4½	3	*13	16	12½
*1¾	4¾	3¼	14	17	13½
2	5	3¼	15	18	14¼
2½	5½	3¾	16	19	15¼
3	6	4	*17	20	16
3½	6½	4½	18	21	17
4	7	4¾	*19	22	17¾
*4½	7½	5¼	20	23	18¾
5	8	5½	21	24	19½
6	9	6½	*22	25	20½
7	10	7¼	*23	26	21¼
8	11	8¼	24	27	22¼

* The Committee suggests that, for general use, these sizes be dispensed with.

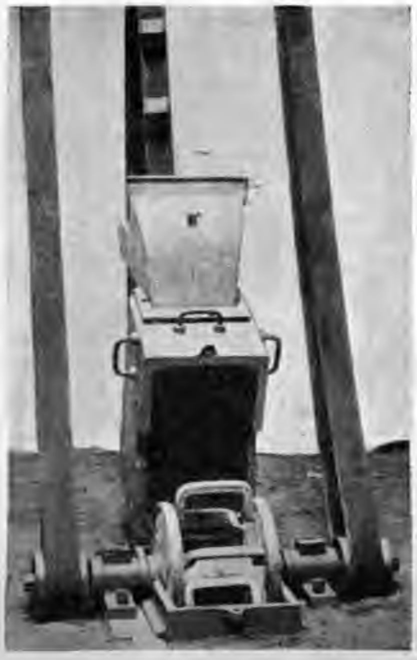
In Unequal Tees having branches varying in diameter in a ratio of not more than 3 to 1, the dimensions are to be those given in the above Table for the largest diameter branch.

A New Crushing Machine.

We illustrate, by the courtesy of the Patent Clêro Crusher, Ltd., of 65 and 66, Chancery Lane, London, W.C., a new form of crushing machinery, which is likely to play an important part in mining operations.

This is constructed on the principle of centrifugal force and consists mainly of a shaft revolving with a velocity of 1,000 to 1,600 revolutions per minute, to which shaft are keyed two heavy flanges or discs that revolve with it and act as flywheels. In these flanges are journalled a number of successive beaters, usually six, in the shape of cranked axles. The bottom of the apparatus is constituted by two curved perforated plates, each covering one-fourth of the circumference of a circle, and serving as screens to allow of the escape of the disintegrated matter. They are formed in two halves to allow of their being easily withdrawn and replaced without interfering with any other portion of the apparatus. Several steel cushions placed within the rear face of the casing assist in the process of disintegration. A casing and hopper for the introduction of the material to be disintegrated complete the crusher. The casing, with the hopper, pivots round a hinge to facilitate the inspection and cleansing of the apparatus, and the replacement of the beaters and screens.

On the shaft being set in motion, the beaters assume a radial position with respect to the shaft, and strike the material introduced into the hopper, slightly clearing the semi-circular screen fitted in the lower part of the casing.



THE PATENT CLERO CRUSHER.

The particles thus struck are violently thrown against each other, and also against the steel cushions within the casing, and are rapidly reduced to the required degree of fineness when they escape through the screen to be carried away.

This form of crusher claims attention by reason of its simplicity, facility for exchanging parts, portability, small wear and tear, great output and economy of power. It is made in two sizes, 1 and 2, having the following dimensions:—

	Size No. 1.	Size No. 2.
Width of the chamber	16 in.	32 in.
Over the pulleys	43 ,,	90 ,,
Length	27 ,,	55 ,,
Height	32 ,,	62 ,,

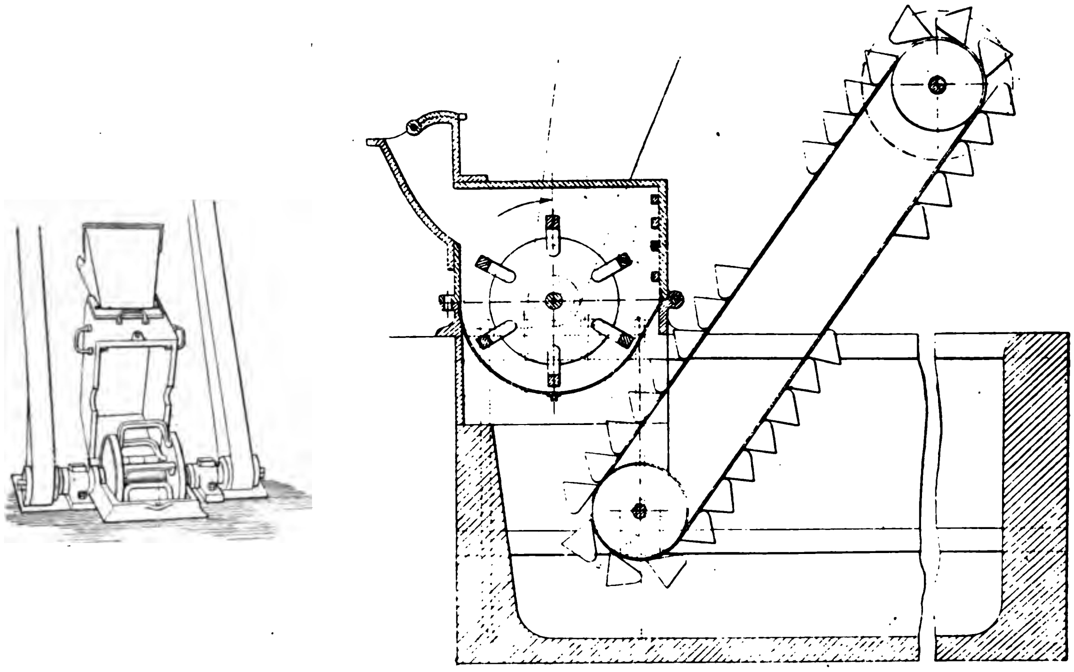
Crusher No. 1 weighs about 1,500 lb., No. 2 about 2 tons and they can also be made in sections. The power required for No. 1 is from 4 to 8 h.p. according to the substance to be ground and the degree of fineness required. The larger size requires from 25 to 30 h.p.

With the above-mentioned h.p. the smaller machine pulverises from 2 to 4 tons per hour of such substances as plaster of Paris, barites, cement clinker, slag, glass, coal, pottery ware, moulders' sand, quartz, mineral ores, etc., etc. The output of the other machine is from 5 to 7 times as large, and we are assured that it will pulverise in one hour as much as 30 tons of gypsum for plaster of Paris, and over 15 tons per hour of such substances as steel slag, quartz, mineral ore, etc.

We understand that some interesting experiments will shortly be made with this appliance. In the meantime, we note that the municipality of Paris has recently granted a concession for the pulverisation of the town refuse of Paris with this form of crusher.

At Paris it has been found that a No. 2 Crusher consuming 30 h.p. will pulverise 10 to 12 tons per hour of town refuse. This refuse is very heterogeneous. It is not previously picked by hand, as it formerly was, but is at once put through the crusher, and it leaves the screen in the form of a blackish mould, perfectly homogeneous, and ready to be delivered at once as manure.

The calendar of the City of Bradford Technical College for the session 1904–1905 is a substantial volume bound in cloth, with some 300 pages of text setting forth detailed particulars of the numerous day and evening classes. The work is divided into three main sections, presided over by Professor A. F. Barker, Professor W. M. Gardner, and Professor G. F. Charnock, M.Inst.C.E., M.I.M.E.



SECTIONAL VIEWS OF CLERO CRUSHER.

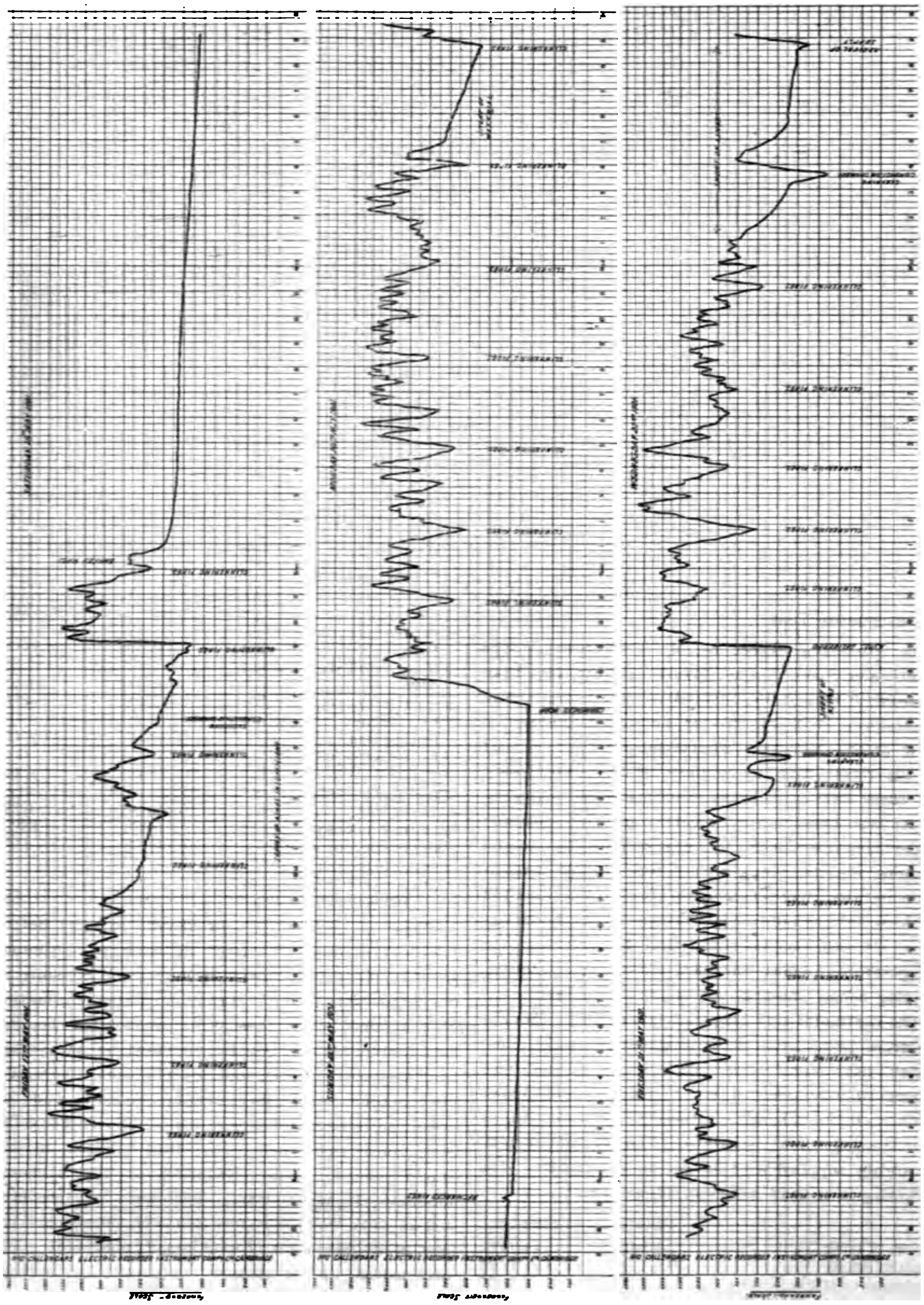
A Destructor Test.

An interesting report by Mr. Stromeyer (of the Manchester Steam Users' Association) has just been received, dealing with a two days' test of the Nelson Destructor. This report has an added interest in view of the calculated composition of the fuel part of the refuse from an analysis of the waste gases. On these tests a Callendar electrical recording pyrometer was fixed in the downtake of the Lancashire boiler connected with the destructor. The accompanying diagram for a week's run is interesting as showing that the temperature during the week-end banking did not fall below 300 deg. F. in the downtake. It will also be noted that the effect on the temperature of every operation of feeding, clinkering, clearing ashes, banking, etc., is duly recorded.

The destructor was designed and erected by Messrs. Meldrum Bros., Ltd., of the engineering works, Timperley, near Manchester, and is of their front feed regenerative simplex type. It has one continuous grate 20 ft. by 5 ft. in a furnace chamber 22 ft. by 6 ft. having four separated and closed ashpits, separately supplied with hot air under pressure. The following is a brief summary of the trial:—

	Tuesday.	Wednesday.
Dates of trials .	13.1.03.	14.1.03.
Time of trials	10—5.45	9.35—6.35
Duration of trials, hours ..	7·75 ..	9·00
Boiler pressure, mean lb. ..	135·1 ..	134·2
Corresponding temperature .. .. F. ..	358·2 ..	357·8
Refuse burnt during trial .. .. lb. ..	45,416 ..	43,400
Refuse burnt per hour, lb..	5,837 ..	4,822
Feed water supplied during trial .. lb. ..	63,723 ..	67,485
Feed water supply per hour .. .. lb. ..	8,191 ..	7,498
Feed water supply per lb. of fuel .. lb. ..	1,419 ..	1,555
Moisture in steam per cent.	1·07 ..	1·034
Temperature of feed F. ..	37·3 ..	33·3
Evaporation per lb. of fuel from and at 212 deg. F. including steam jets, lb.	1·698 ..	1·877

Table II. included in the report, contains details which were only obtainable by making continuous and complete gas analysis, including the moisture in the waste gases. With the help of the information thus obtained it was possible to calculate the chemical composition of the fuel (it contained on an average 31·4 per cent. carbon, and 0·5 per cent. hydrogen), its calorific value (4·6 evaporative units) and the weight of waste products per pound of refuse (5·6 lb.) were then calculated. The heat utilised in the production of steam (exclusive of the blowers), amounted to 36 per cent., which must be considered a high duty when it is seen that the carbon and the heat in the ashes account for a loss of 20 per cent. The heat carried up the chimney amount to an average of 19·3 per cent. which is reasonably low.



NELSON DESTRUCTOR.

Diagram of temperature in Downtake of Lancashire Boiler taken with a Callendar Electrical Recording Pyrometer.

NAVAL NOTES.

WEEKLY NOTES ON NAVAL PROGRESS IN CONSTRUCTION AND ARMAMENT.

(BY OUR NAVAL CORRESPONDENT.)

FRANCE.

THE changes which have been brought into effect in the British Navy during the past few weeks have attracted much attention in France, where the possibility of carrying out similar reforms in the effective list of the French fleet have been widely discussed. Numbers of old torpedo-boats and cruisers are still classed as efficient, but are of absolutely no fighting value. Such vessels as the *Sfax*, *Tage*, *Cecille*, *Isly*, and *Jean Bart* might be relegated to the scrap-heap without in any way affecting the fighting strength of the fleet, and economies in the naval budget would naturally follow.

The trials of the *Dupetit Thouars*, which has been a long time under construction, but which is now ready for service, were fairly satisfactory, and her coal consumption at cruising speed was within a decimal point of the prescribed figure. The *Guichen* has been commissioned, after sundry vicissitudes, but the trials of the *Leon Gambetta* have been postponed,

GERMANY.

That there is every intention of turning Emden, on the north-west coast of Oldenburg, into a naval base, seems certain, and there, as at Wilhelmshaven, large sums are being spent on "improvements." A semi-official report states that the enlargement of the works at Wilhelmshaven has been "rendered necessary by the circumstance that most of the private yards in Germany have accepted orders for Russia, which will keep them fully occupied for years." It is of course well known that the majority of vessels at present building for the German navy have been constructed by contract, and no doubt it is considered advisable to prepare the public yards for any access of works which the acceptance by the Reichstag of a new Navy Act would entail. At Kiel and at Danzig further ships and docks are being built, and where 6,000 men are at present employed it is expected that there will be shortly work for 14,000. Two new protected cruisers, the *München*, and the *Undine*, have been commissioned both at Wilhemshaven on January 11th. The battleship *Lothringen* is also progressing favourably, her funnel and masts being already in place. It is expected that at least one battleship and four armoured cruisers will be launched during 1905, and a large number of vessels should hoist the pennant before next Christmas.

RUSSIA.

The game which Admiral Virenius played round Djibutil, the Red Sea, and the Levant last spring, is to be copied by Admiral Rojestvensky during the next three months, and he is to potter about among the islands of the Indian Ocean, taking care not to go too near the Archipelago. This it is to be presumed is the Russian interpretation of the term "a fleet in being," but how far it will serve to hamper the operations of the Japanese is not easy to determine. That the neutrality of this country and others will be very seriously imperilled with this base-less fleet-errant in search of coal and supplies is obvious, and the fact that the Hamburg American line have reportedly entered into contracts to send sixteen vessels with supplies to any neutral port not east of Colombo during the next three months, points to the likelihood of some island in the Indian Ocean west of the 80th deg. of longitude being chosen for a base. In any case Admiral Rojestvensky has no very heroic role to play. He may neither advance nor recede.

Meanwhile, plans for the re-building of a powerful fleet are maturing, and rumours and denials are rife. The programme published in these columns in the issue of January 13th, was a large one, but it is the only one which up to the present has any semblance of probability about it, and until official information is vouchsafed, if ever, we must be content to look upon that as being the aim of Russia's ambition, so far as a fleet for immediate use is concerned.

ITALY.

Early in the spring, possibly even before the end of February, the armoured cruiser *Francesco Ferrucio* is to join the active squadron in the Mediterranean.

Referring to my remarks last week, on the question of battleships of large dimensions, it may be of interest to note that in an official report on the operations in the Far East, the Italian Ministry of Marine is informed that the existing types of Italian vessels are not adapted to the needs of a long naval war, and two squadrons, of battleships and armoured cruisers should be formed, the first to displace 16,000 tons and over, and the second to be light and rapid, but well armed. Should these recommendations be acted upon, Germany would be the only one among the Great Naval Powers, which continued to build battleships of small displacement.

Design and Construction of American Planing Machines.

By Archibald Kendrick.

BETWEEN this country and America there is a difference of conditions, which manifests itself all through the design and construction of a machine, from the general features down to the smallest detail.

Thus there are many instances of American firms specialising in one tool and adhering to standard patterns even in this. Great excellence of quality and refinement of detail is the result.

Several works where planing machines are made have been visited by the writer, and machines were seen in operation in many places. The machines seen in America were made of distinctly thin metal throughout and the outside appearance was everything that could be desired. Better shapes can be given to castings if their models are kept standard and are not altered. In one works, to economise shop room, only the cross-slides, boxes, gearing, feed motion and other light parts were made to stock. The heavier parts were cast, and quickly got up when an order was received.

Beds mostly have the usual V's, planed considerably more acute than 90 deg., and are generally lubricated with rollers. The V has the advantage of requiring no setting-up slips: while flat ways are easier to lubricate, to get true on foundations and to keep true afterwards: all especially useful for long machines. Flat ways also are better for heavy work. In the larger sizes many new machines are being made with a guiding V on one side and a flat on the other

Tables are furnished with longitudinal T-grooves and dog-holes at intervals. The cross-slides have a rectangular guide at the top with some sort of slip, and a V-guide near the bottom (fig. 1). American machines do not plane on the return stroke, and this arrangement forms a first-class support for the cutting stroke.

Reference should be made to the great precision of the work and to the steady running secured.

NEW DEVICES FOR DRIVING.

Some firms employ friction clutches in the drive instead of belt striking gear, especially for the larger machines. These are easier to throw than belts, and they give rise to less variation in the length of stroke. Still better results in this direction were obtained by a new device seen on an 8-foot square machine, where at the points of reversal a cock opens admitting compressed air which blows the clutch across

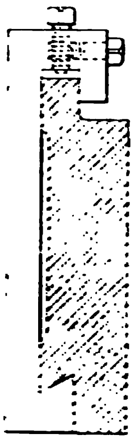


FIG. 1. SECTION OF CROSS-SLIDE CARRYING TOOL-BOX SADDLE.

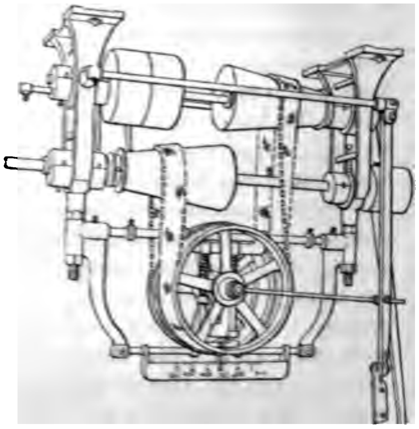


FIG. 2. SPEED-CHANGING DEVICE.

from one gear to the other. Friction-clutch machines are motor-driven very conveniently without a countershaft. Two other forms of drive were seen at Cleveland in which electricity played a prominent part in reversing. In one, an electro-magnetic clutch was pulled alternately to the direct and to the reverse gear. In the other, the knockers threw a switch which reversed the field magnetism and so the rotation of the motor, and also gave it a quick return speed. It was done by a new type of Westinghouse motor which was attached to one of their existing machines. This seems to be the most direct way of all.

In American planers a very high rate of speed is obtained on the quick run-back stroke, being about four or five times the cutting speed. But the cutting speed is nothing extraordinary, and the quick-cutting steels do not seem to have asserted themselves yet. When they do, they will raise the speed of the cutting stroke, but not that of the return, which is probably already as high as is feasible. The next step may be to run the machine at a constant high speed both strokes, and cut with double-cutting tool-holders. In several works where they wished to increase the output of existing machines, planers were run from a Reeve's variable speed countershaft, which gave great satisfaction.

Another new speed-changing device was shown at the World's Fair. This was based on the familiar apparatus consisting of two cast-iron taper cones geared together by a belt with forks to locate the belt and keep it from climbing. For the forks were substituted two guide pulleys as shown in fig. 2. This arrangement allows a good length of belt, and obviates the continual friction on the forks. The belt was a link belt (though it might have been a common belt), and was kept tight by springs acting on the guide pulleys. It worked well and had great driving power.

Abstract of a paper read before the Institution of Mechanical Engineers.

Mallet Articulated Compound Locomotive (B. and O. R. R.)

BY THE AMERICAN LOCOMOTIVE COMPANY

THE following are the chief dimensions and details of the locomotive illustrated on pages 190 and 191 :—

Class	0-6-6-0.
Gauge	4 ft. 8½ in.
Fuel	Soft coal.
Weight on drivers	334,500 lb.
Weight, total	334,500 lb.
Weight, tender, loaded	143,000 lb.
Wheel base, total, of engine	30 ft. 8 in
Wheel base, rigid	10ft
Wheel base, total (engine and tender)	64 ft. 7 in.
Length over all, engine	51 ft. 5½ in
Length over all, total, engine and tender	80 ft.
Height, centre off boiler above rails	10 ft.
Height of stack above rails	15 ft.
Heating surface, firebox	219 square feet.
Heating surface, tubes	5,366 square feet.
Heating surface, total	5.585 square feet.
Great area	72 square feet.
Drivers, diameter	56 in
Journals, driving axle, size	9 in. by 13 in.
Main crank pin, size and length of	6½ in. by 7 in.
Cylinders, diameter	20 in. and 32 in
Piston stroke	32 in
Piston rod, diameter	3¾ in.
Main rod, length centre to centre	9 ft. 7¼ in.
Steam ports, length	h.p. 23½ in., l.p. 20 in.
Steam ports, width	h.p. 1¾ in., l.p. 2⅜ in.
Exhaust ports, length	h.p. 23¼ in., l.p. 20 in.
Exhaust ports, width	h.p. 1¾ in., l.p. 3 in.
Bridge, width	l.p. 1¼ in.
Valves, kind of	h.p. 10 in., piston l.p. slide
Valves, greatest travel	6 in.
Valves, outside lap	h.p. 1⅛ in., l.p. 1 in.
Valves, inside lap or clearance	h.p. ¼ in., l.p. ¼ in.
Valves, lead in full gear	h.p. ⅛ in., l.p. ⅛ in
Boiler, type of	Straight.
Boiler, working steam pressure	235 lb.
Boiler, material in barrel	Worth steel.
Boiler, thickness of material in barrel	1 in.
Boiler, diameter of barrel	First ring 84 in.
Seams, kind of horizontal.	Butt jointed, sextuple riveted
Seams, kind of circumferential	Double riveted.
Thickness of tube sheets	½ in. back, ¾ in. front.
Thickness of crown sheet	7-16 in.
Crown sheet stayed with	Radial stays.
Firebox, length	108 in,
Firebox, width	96 in.
Firebox, depth, front	80 in.
Firebox, depth, back	72 in.
Firebox, thickness of side and back sheets	⅜ in.
Firebox, water space, width, front	6 in., sides 5 in
Grate, kind of	Rocking
Tubes, number	436
Tubes, material	Charcoal iron.
Tubes, outside diameter	2¼ in.
Tubes, length over sheets	21 ft.
Smokebox, diameter	85 in.
Smokebox, length	84 in.
Exhaust nozzle., diameter	5½ in.
Stack, diameter	20 in.

STEEL FOR THE MANUFACTURE OF ARTILLERY.

By Colonel Cubillo (Spanish Royal Artillery).

IV.

(*Continued from page* 120.)

HAVING referred to the companies which provide the first materials for the national arsenals, it will be interesting to examine the works of the latter—their principal features and methods of construction. The only national factories I have visited are the Naval Arsenal at Washington, the old parks or arsenals of Watervliet and Watertown, and, lastly, the rifle factory at Springfield.

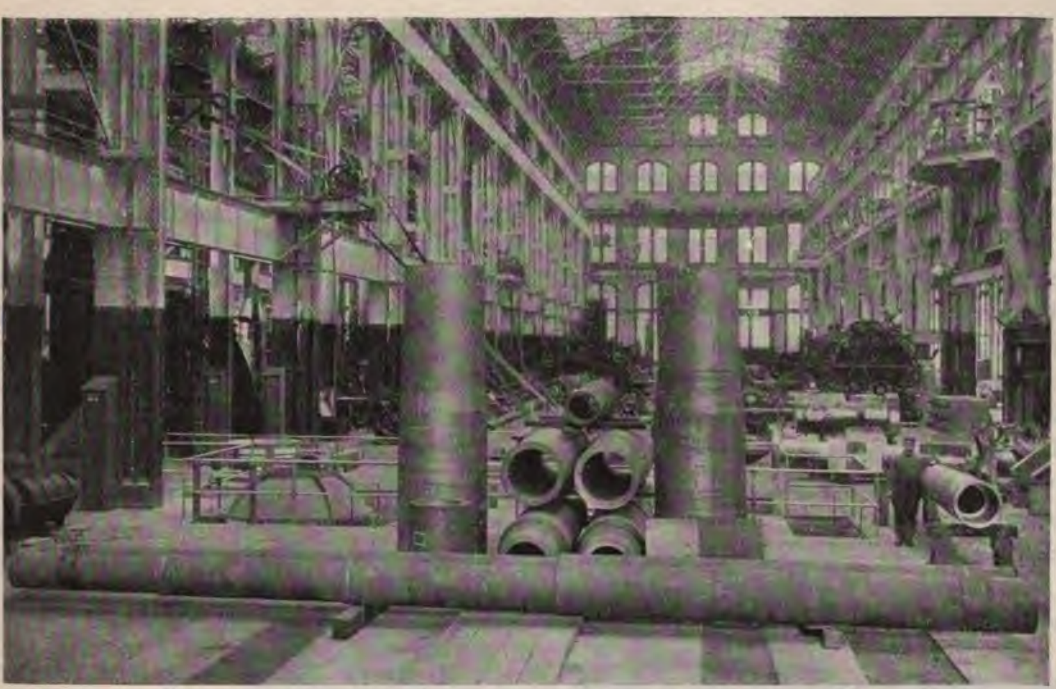
THE WASHINGTON ARSENAL.

This is situated in the federal district of Columbia, on the river Potomac. The depth of water is more than sufficient to allow the entry of the required raw materials and to despatch the finished products to the proving grounds, or other destination. The situation is such that it is covered from attack by a hostile fleet, and its communication lines, including the points which provide its raw materials, are in no danger of being destroyed by an enemy.

When the Government decided to establish its naval arsenal at Washington, the reforms necessary were by no means inconsiderable. The old shipbuilding sheds had to be demolished and replaced by new ones. Other modifications have had to be made to suit the present requirements, as in the case of the old arsenal reconstructed after its destruction by the English in 1814, from the slips of which were launched the famous frigates *Columbia* and *Potomac*, now used as an artillery workshop. The most important shops of the arsenal are: the cannon shop, divided into two sections, north and south; the carriage shops, in two sections, east and west; the lock mechanism; the forging and pattern shops; the foundry; metallic cartridge department and the tool shop. In the gun shop, one naval lieutenant is in charge of the manufacture of the 4-in., 5-in., 6-in., and 7-in. guns; there is another for the 8-in. to 13-in. guns, and a third lieutenant attends to the 3-in. guns, and all kinds of accessories. There are three powerful electric cranes worked by eight electric motors.

In the centre of the workshop is the shrinking pit, which is made of sufficient depth to receive the tubes of the largest guns, and vertical gas furnaces; also to heat sleeves of the greatest dimension. The hoops and short sleeves are placed horizontally. The tools employed in the boring and screwing are similar to those now used in Trubia, where American tools have been used with great advantage. In one thing the Washington Arsenal is ahead of Trubia—the rifling head carries four tools instead of one, and does the work in a third of the time. This cannon workshop contains 151 machines of all kinds. I think it a very good idea to have the lock-mechanism shop in a different part of the building provided with 113 machines. The carriage department employs 237 machines, 28 of which are horizontal boring machines, well adapted for the construction of the gun cradles.

Another worthy of notice is the forging shop; this is not limited to pieces which may be forged by a one-ton hammer, of single or double action, but undertakes forgings of much greater weight. A twenty-five-ton crane runs from end to end of the shop. In the pattern department great improvements have been made during the past year; the system for the expulsion of the sawdust into a collector placed outside being one of the most important; the shavings are also disposed of in a similar manner after separation from the machines by



GROUP OF NICKEL STEEL FORGINGS FOR 8-IN. AND 10-IN. RIFLES, BY THE MIDVALE STEEL COMPANY.

A description of the factory will be found on page 12, No. 17.

means of electrically-driven fans; this method saves hand-labour and diminishes the risk from fire. The metallic-cartridge department is very similar to the one at Trubia, but more complete. The Americans smelt and roll the brass required; Trubia starts with the metal in discs. As regards the rest, the pumps and accumulators, the vertical press to make the cup, the horizontals and the two of 2,500 and 1,000 tons, to head the cartridges, are exactly like those at Trubia.

The American factory has also some smaller presses for the manufacture of 75-millimetre cartridges. The draughtsman's department of this arsenal calls for special notice. In the year 1902, 880 original plans were prepared, and 28,000 blue print copies were distributed among the different branches of the naval service. The department had to be increased last year, owing to the great amount of work. All plans are kept in fireproof safes.

Instead of publishing and sending the drawings of artillery material to the officers, the Washington Arsenal had photographic reductions made, conveniently classified and bound in book form. In this way each vessel has a complete plan of all its artillery.

I will now give a few details regarding the annual expenditure and production. From May, 1887, when the works were first started, until the end of June, 1902, 1,210 guns of all calibres had been made, and 281 were still in hand. The cost of hand-labour increased from $210,093 in 1886-7, to $1,746,168 in 1901-2. The machines at the end of 1902 numbered 1,223 of all classes, having increased from 405 in the last ten years. Lastly, there are nineteen officials and 2,115 workmen.

As happens in all navies and armies, the Americans construct different models of the same calibre; but it appears that they are going to adopt, or have already adopted, a fixed criterion as regards the length of the gun, assigning forty calibres to the 12 in. and 10 in.; forty-five to the 8 in., 7 in., and 6 in.; and fifty to the 6 in., 5 in., 4 in., and some of the 3 in. There are also 3-in.

semi-automatic Maxim-Nordenfeldts and Driggs-Seabury Company guns.

The American Navy is well satisfied with the results obtained with the Firth-Stirling projectiles, which combine the advantages of armour-piercing and ordinary shells, that is to say, they pierce the armour and carry more than a medium explosive charge if desired. The test for these projectiles is the following: At a certain velocity they must pierce a hardened plate of one calibre thickness, and then explode.

American officers do not think that we have reached the power limit of artillery. They intend to adopt a pressure of 3,000 kilogrammes per square centimetre as the normal for steel pieces; the length to be fifty calibres for the 6-in., 7-in., and 8-in. guns, and the metal to be nickel-steel.

Adjacent to the proving ground at Indian Head the American Government has constructed a smokeless powder factory. Last year 496,353 lb. of powder were made, to produce which 378,500 lb. of ether, 1,275,492 lb. of sulphuric acid, and 516,575 lb. of gun-cotton were used. The factory is capable of producing 3,000 lb. of powder daily; except in the summer months, when, owing to scarcity of water, only 2,400 lb. can be made.

Experiments have been made with a colouring matter, which should indicate on the decomposition of the powder, and consequent alteration in colour, the stability of the explosive. The director of the factory is of opinion that this test should be employed to avoid the necessity of the inspections which are now practised.

(*To be continued.*)

SHRINKAGE PIT AND FURNACES IN NO. 2 GUN SHOP EXTENSION—MIDVALE STEEL COMPANY.

OUR WEEKLY BIOGRAPHY.

MR. WILLIAM JACKS, J.P., LL.D.

MR. WILLIAM JACKS, formerly Member of Parliament for Leith and Stirlingshire, founder of the well-known firm of iron and steel merchants, was born March 18th, 1841, at Cornhill-on-Tweed. He was educated at the village school, Swinton, Berwickshire; the training he received there, however, was only of an elementary nature, but he was an enthusiastic student and the desire for knowledge acquired in his early youth proved a strong factor in the formation of his character.

His business career began in 1855 when he was apprenticed to a shipbuilder at West Hartlepool. Upon the expiry of his time, he entered the counting-house of a ship-building firm on the banks of the Wear. When not engaged in business his leisure hours were judiciously divided between the study of modern languages, German literature, mathematics, political economy, etc.

In 1863 he was appointed manager of the Sunderland and Seaham Engine Works and Foundry. Six years later he became manager of Messrs. Robinows and Marjoribanks, foreign iron merchants, Glasgow. He eventually retired from this firm in order to establish his own business as an iron and steel merchant. Apart from the management of Messrs. W. Jacks and Co. (London, Glasgow, and Middlesbrough), Mr. Jacks is also a director of several large limited companies, and is financially interested in iron and steel works in Britain and in Canada.

In 1885 he entered upon his parliamentary career as member for Leith Burghs, while in 1892 he was again returned to the House of Commons as the representative of Stirlingshire.

In 1901 he was elected President of the West of Scotland Iron and Steel Institute, and was for several years, president of the British Iron Trade Association, and is now President of the Glasgow Chamber of Commerce.

Mr. Jacks is very enthusiastic on the subject of commercial education, and is president of the Council of the Commercial College, Glasgow. He is of opinion that boys obtain a better training in a properly conducted office and in the efficiently equipped night schools than they get in ordinary educational institutions. A strong advocate of the system of profit sharing as a a remedy for strikes, Mr. Jacks adopts the plan in his own business and tries to introduce it wherever possible. The honorary degree of LL.D. was conferred upon him by the University of Glasgow for his contributions to literature.

Photo by Elliott and Fry.]

MR. WILLIAM JACKS. J.P., LL.D.

QUESTIONS OF THE DAY

The National Encouragement of the British Inventor: How can it be secured? (*Continued from page 125.*)

MR. THWAITE now concludes his reply to correspondents in this important discussion, as follows :—

THE DEADENING EFFECT ON A NATION'S PROGRESS OF A NON-PATENT POLICY.

It is suggested by only one of your correspondents (Mr. Erith) that most of the inventions would be developed irrespective of patent protection. I would like to ask him how many inventions have been developed in Holland ?

No manufacturer would risk the expenditure involved in the technical and commercial perfection of an invention unless he was satisfied that he had at least a problematical chance of establishing a proprietorship under the ægis of a patent.

Your correspondent draws attention to the renewal fees in force in Germany. I may tell him, from intimate experience, that as regards German patents granted (to Germans) after the search by an exceptionally practical staff, had it not been for the strongly protectionist fiscal policy, and the mercantile banking system which this policy has created, the objectional renewal fee taxation of this German patent system would long ago have suppressed the public exhibition of a great part of German inventive effort.

THE INFLUENCE OF THE AMERICAN PATENT POLICY ON THE PROGRESS OF THAT COUNTRY.

My knowledge of the causes furnishing the American prosperity can be found by your correspondents in the "American Invasion," one of the "Burning Question" series published by Messrs. Swan Sonnenschein and Co., London, as to the effect of the American cheap patent policy. The best judges are the experts at the head of the American Patent Department. I give an expression of opinion from this source, selected from others equally as emphatic, by Commissioner C. H. Divell.

"I assert without fear of contradiction, that we Americans owe to our patent system such foothold as we have gained in foreign lands for our manufactured products."

I commend this opinion to the notice of your correspondent, Mr. Erith. One of your correspondents expresses the opinion that because a demand is established for a foreign manufactured patented article, this justifies its introduction into this country under the ægis of an unworked patent, prohibiting for long years the home manufacture of an article that may displace another home-made product. This exhibits a strange ignorance of the effect of the policy permissible in the old Act, which has played sad havoc with some of the Lancashire and Yorkshire chemical manufacturing industries. No! A reciprocal compulsory working policy is the one to be recommended. The subject of a country which places our inventions under a working obligation should receive the same treatment in this country.[*]

THE WEALTH OF ANY COUNTRY DEPENDS ALMOST ENTIRELY UPON THE INVENTIVENESS OF ITS INHABITANTS.

Some years ago I received special and valuable data from the United States Census Department, by which I was able to draw a comparison between the wealth *per capita* of different states, and its relation to the inventiveness of such States.

For example, the wealth of the following States—

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[*] A German inventor establishes in his country a manufactory; he refuses to licence the right of manufacture in this country except on impossible terms, and as the law exists, no one can blame him. During the years of his monopoly of importation into this country, he perfects his machinery, and his workmen become experts; he extends the life of his patents whenever possible by patenting details, so that when his British patent life expires, he relies on his detail patents. Thus the establishment of the British factory is indefinitely deferred.

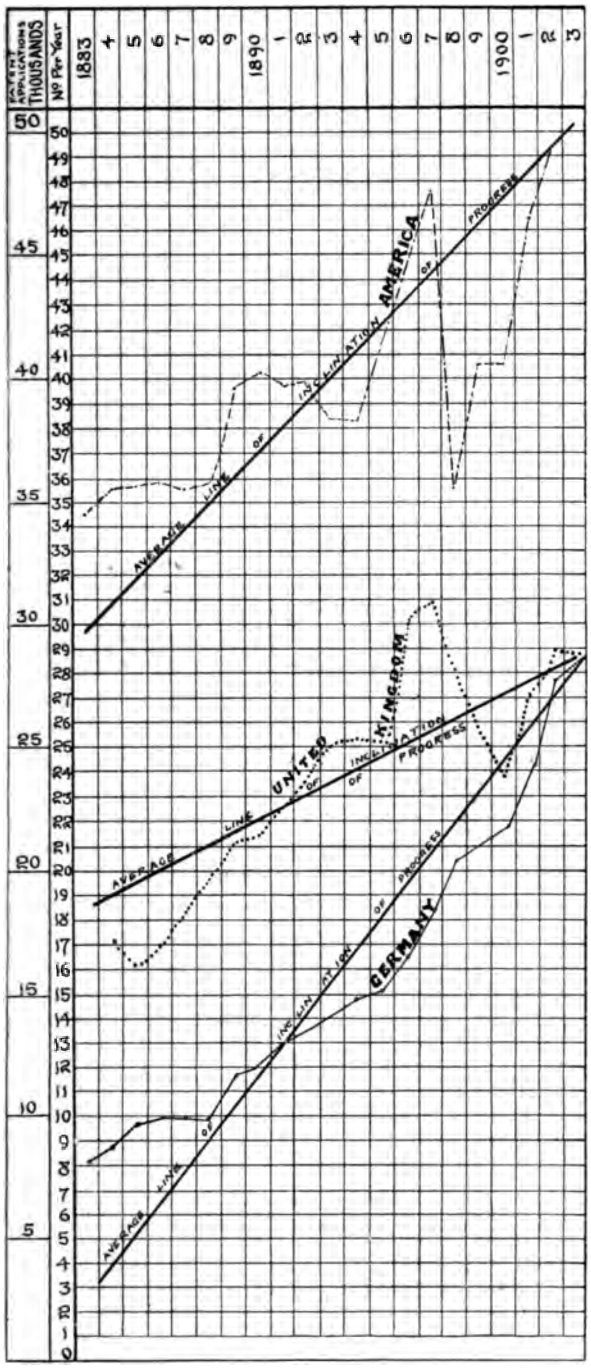

FIG. 2.

Diagram showing progress of inventive activity in America, the United Kingdom, and Germany during the twenty years ending 1903.

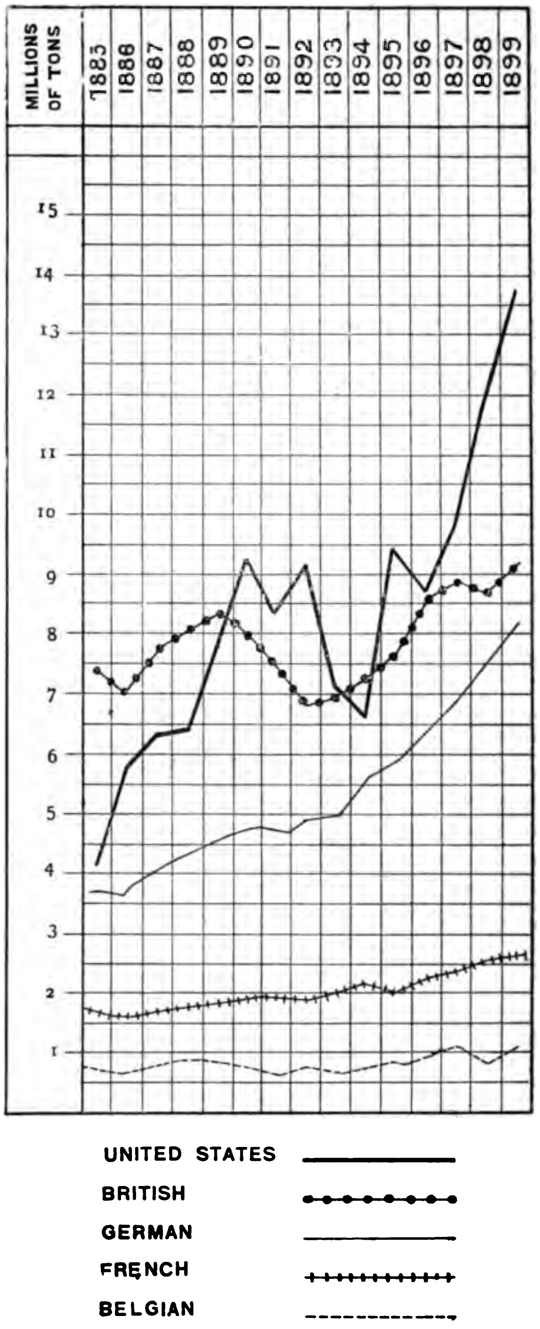

FIG. 4.

Showing comparative progress of the five great iron-producing countries in the production of pig-iron—1885-1899.

Massachusetts, New Jersey, Rhode Island, Colorado, Montana, District of Columbia and Connecticut, if distributed to each unit of population would be equal to the division of $682 per head. In these States one American patent in each group of 1,108 of the population is annually applied for.

If distributed to each unit of population of the following least inventive of the American States—Virginia, West Virginia, Arkansas, Tennessee, Georgia, Mississippi and South Carolina, the wealth would provide only $176 per head of population. In these seven states only one patent is annually applied for to each group of 15,550 inhabitants.

It may therefore be said that the comparative material advance and prosperity of a country can be measured by the patents annually applied for, compared with the population.

STATE INDIFFERENCE TO THE INVENTOR.

If one required to demonstrate how indifferent the British Government—Tory or Radical—is to the all-important subject (according to George Washington) of providing adequate encouragement and protection for inventors, one need only refer to the character of the Royal Commission (and its evidence) appointed and arranged to investigate the defects of the existing Patents for Inventions Act, and formulate remedying reforms. Such a Commission in other countries would have been constituted with at least 50 per cent. of inventors, and 90 per cent. of the witnesses at least, would have belonged to the inventor's class for which the Act under consideration directly affects. But no! The opinion of the inventors of the country was practically ignored, and only one-tenth part of the evidence could, by any stretch of imagination, be termed the representative opinion of the British inventor.

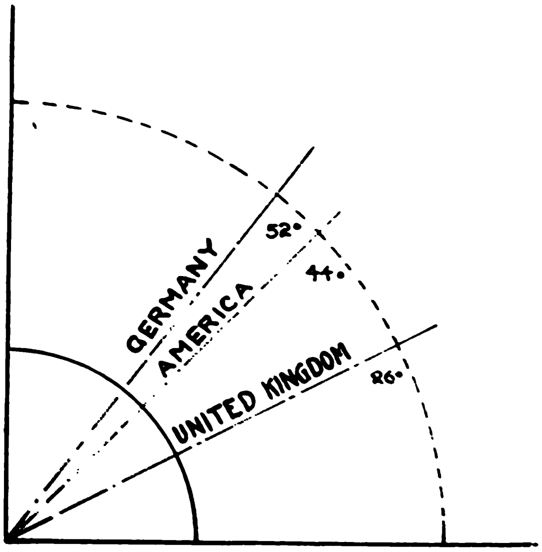

FIG. 3.
Average comparative progress of inventive expansion.

The graphic diagram (fig. 5) is quite eloquent on this point. The subject under discussion is not a political one, but it may, nevertheless, be observed that if this *laisser faire* (others call it *blundering* policy) is allowed to continue, our commercial and industrial efficiency, when tested in the balance against the cosmic and inventor-encouraging organisations of our great competitors, will be still further outweighed.

Mr. Abel, in his thoughtful and appreciated address, draws attention to the magnificence of the German and the American Patent Office Buildings. Let anyone compare these temples and their splendid sites with the character and position of the new British Patent Offices, and he has an ocular demonstration of the comparative estimation of inventors by the three countries.

HOW THE GERMAN AND AMERICAN INVENTORS ARE ASSISTED IN THE WORK OF COMMERCIAL PROTECTION AND EXPLOITATION OF THEIR INVENTIONS.

The British inventor has not, like his German contemporary, the advantage of the splendid stimulus to enterprise represented by the German Mercantile Banking system—by which selected inventions of promise are developed, and commercially introduced under the best conditions to secure success. This Mercantile Banking System, protected as it is by the Bismarck policy of strong Protection, is responsible for a part of the marvellous progress of Germany during the last twenty years, a reference to the graphic diagrams (figs. 3 and 4) show the remarkable development of inventive activity in Germany, and the extraordinary correlation of the progress of the iron-making industry with the expansion of inventive effort. The American inventor has the advantage of the remarkable enterprise of the United States, fostered as it was by the effect of the McKinley fiscal policy.

If we cannot have a strong Protectionist fiscal policy, let our inventors, therefore, have, at least, the encouragement that can be given to them by a wise and generous Patent Act.

THE COMPULSORY SUBDIVISION OF AN INVENTION INTO SEVERAL PATENTS, AND ITS EFFECT.

The Comptroller under the provisions of the new Act, may require an inventor to apply for two patents, or even three, as is done, and very rightly, by the United States Patent Office, assuming that an invention requires to be covered by three applications, thus the patent fees cost to the applicant for a 14 years' life will approach to the figure of £300, independently of agent's charges. The fees for the three applications in the United States for a life period of 17 years will not exceed £25, or exactly one-twelfth of the British charges. The effect of such taxation can easily be foreseen. The disastrous effect of the British renewal fees of the old Act is serious enough, but the effect of the new Act of Sub-division, if insisted upon, will probably extinguish the life of 90 per cent. of British patents after the fifth year.

THE OFFICIAL EXHIBITION OF ANTICIPATIONS.

In my opening letter I particularly pointed out that one of the defects of the new Act is the power it gives to the Comptroller of the British Patent Office to destroy the commercial, or indeed any proprietary value of a patent, by published references to (arbitrarily defined) anticipations, and on the face of the patent specification, I notice that this regulation is being condemned by eminent patent experts. It is suggested that in lieu of this regulation, option should be given by the Comptroller to the inventor applying for a patent to interpolate in the usual disclaiming terms, in the body of his specification, a repudiation of any intent to encroach on the proprietary rights of any of the patents considered by the Comptroller to constitute anticipations, but not necessarily accepted as such by the applicant for a patent.

THE TRUE INDEX OF A NATION'S INDUSTRIAL PROGRESS AND COMPARATIVE PROSPERITY.

Years ago I laid down the proposition that the true index of any nation's industrial and commercial position was not that of the Disraelian axiom, *ergo*, the state of the Chemical Industry—but that of the Iron and Steel Industry—but there is another index almost as valuable and true, and that is the degree of activity of a nation's inventive faculty, represented by the numerical proportion of the applicants for patents for inventions.

A comparison instituted between the proportion of the application for patents in the three countries, America, Germany, and the United Kingdom, is of peculiar value, as an index of comparative progress.*

I have built up in a graphic form fig. 2, on the basis of official statistics, lines representing the proportions of the total applications for patents for different years, beginning in 1883, and ending in 1903.

Along these lines I have drawn others that represent the average progress over the period time defined. These lines are reproduced—projecting from a common centre in fig. 3—showing at a glance the average comparative progress of inventive expansion in each of the three countries, in definite degrees.

A GRAPHIC COMPARATIVE EXHIBIT.

Let anyone compare the graphic diagram (fig. 2) with the graphic diagram (fig. 4) showing the comparative progress in the great iron-making countries in their pig-iron output capacity. It will be noticed, especially applied to Germany, that there is a very remarkable correlation between the inventive activity and that of the iron industry during the last twenty years. The correlation exists, but not to the same extent between the activity of the American iron industry, and that of American inventors. The same comparison applied to the last ten years would to a more serious extent, weigh against this country.

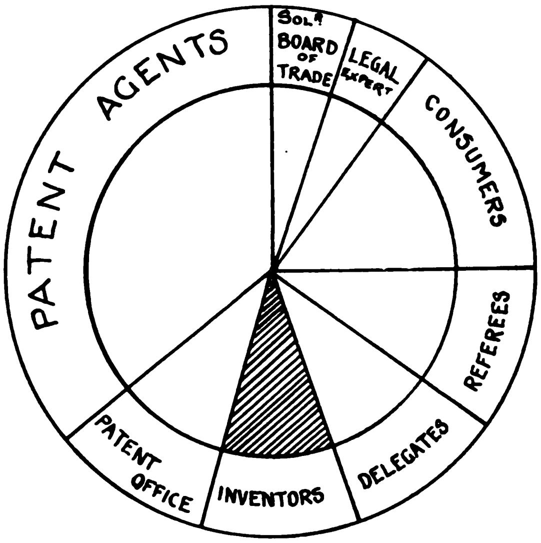

FIG. 5.

Diagram showing constitution of the Commission responsible for the provisions of the new Patent Act.

OBITUARY.

The news of the death of Mr. Wm. Jaffrey has been received with great regret in engineering circles. Mr. Jaffrey had a long and varied experience as an engineer, and played a prominent part in the inception of many important enterprises. From the date of his association with Mr. Kinipple in 1889, he specialised in dock and harbour work, and among other undertakings was associated with the extension of the London docks, and with the engineering work on the Essex and Suffolk coasts, undertaken by the East Coast Development Company. Mr. Jaffrey was also engineer to the Commissioners of Sewers, and to the Aden Port Trust. He was a member of the Institutions of Civil Engineers and Mining Engineers, his earlier years having been mainly devoted to mining work.

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* By the way, there is a misprint in the footnote on page 123. This should read as follows: "Foreign inventors should be compelled to apply for British patents in their own names, otherwise they could easily evade the compulsory working conditions of a reciprocal policy, by arranging for their patents to be taken out by a secret service agent located in this country. This points to the desirabilily of extending the search for anticipations, so as to cover foreign applications for patents."—B. H. T.

LOCOMOTIVE NOTES.

By CHARLES ROUS-MARTEN.

NEW BIG-BOILERED "ATLANTICS."

APPARENTLY the fact that no fewer than twenty-one of the large boilered "Atlantic" engines are now at work on the Great Northern Railway and ten on the North-Eastern must be taken to indicate that Mr. Ivatt and Mr. Worsdell at any rate, deem the single-expansion locomotive type, fortified by a boiler of gigantic dimensions, preferable to the system which has mainly commended itself to the rest of the world, at any rate to the European Continent, and in a large degree to America also, that of making smaller boiler-power suffice by using the same steam twice over, in other words, by compounding. In view of the large European experience now available—there being already at work on the Continent no fewer than two thousand compound engines of the de Glehn type alone, or at least of the type which, through Monsieur du Bousquet's utterance on the subject, has become known as the de Glehn, although Monsieur de Glehn himself disclaims any exclusive right to the credit—it is not quite easy to understand this attitude. In England, it is true, the general public, until the arrival of "La France," had become accustomed to regard locomotive compounding as inseparable from one of two systems—the Webb on the one hand, the Worsdell-von Borries on the other. The recent rapid and steady march of the Webb three-cylinder compounds to the scrap-heap and of the North-Eastern two-cylinder compounds to the converting shop has doubtless done much to emphasise this idea in the minds of those who have not the means of becoming thoroughly acquainted with the circumstances, but manifestly it would be absurd to predicate any such ignorance on the part of the very eminent engineers who have deliberately preferred the non-compound type. One must take it for granted that they have, as they believe, adequate reason for such a decision. But one would be glad to know what that reason is.

THEIR WORK.

Meanwhile, the huge new North-Easters which are now running regularly to Edinburgh with the East Coast expresses, are settling down into their stride, and must in due time be judged by their work. Now, I have made several observations with these engines and have had a number of observations made for me by entirely trustworthy assistants. But I cannot regard as at all complete the results yet obtained. Some competent judges who have written to me about the engines express disappointment that they have not "done better" than previous four-coupled types, such as Nos. 2011–2030, 2101–2110, etc. I mention this because I wish to have the opportunity of saying that I do not regard such a criticism as entirely apposite. If the previous engines kept time with a given weight of train, I do not see why more should be expected even of the enormously more powerful new engines. I remember the same irrelevant criticism, as I judge it, being applied to Mr. Worsdell's six-coupled ten-wheelers when they first came out. "They don't go up the Cockburnspath bank any better than the other engines," it was remarked to me more than once. But why should they? And why should this be expected of them? What was expected of them, and quite reasonable as I understood, was on the one hand piloting should be reduced with existing train-loads, and on the other that if heavier trains had to be hauled in the same services, the new engines would or should be able to take them to booked time as easily as their predecessors did the smaller loads. That was my argument in the case of the six-coupled class, and I take up the same position now as to the "Atlantic" class. I do not see why they should be expected to haul a given load faster than their predecessors, the booked time remaining the same. What I do say is that they may and should be expected to haul considerably heavier loads to the same time. The question is, do they? It is exceedingly difficult to arrive at any very clear knowledge on such a point as this. The materials for comparison in these cases are almost always insufficient. Cognisance has of course to be taken of the cases in which assistant engines were resorted to by the earlier locomotives; conditions of weather and road have also to be duly allowed for It is seldom practicable or convenient for such absolute tests to be undertaken as the rapid running, by different classes of engines, of trains varying in weight. It is still more difficult to effect comparisons between the locomotives of different railways. Otherwise it would be most interesting to see how the Great Northern and North-Eastern "Atlantics" would compare with the London and North-Western "Precursors" or with the latest Webb compounds, as modified by Mr. Whale, on such trains as these two latter classes are now taking without pilot aid, *e.g.*, loads of 400 to 500 tons behind the tender, booked over average roads at mean speeds of 51½ to 53 miles an hour from start to stop.

INCONCLUSIVE COMPARISONS.

But even on their own roads the new "Atlantics" cannot well be compared with their predecessors because of the almost infinitely varying conditions. Still, some rough approximation may be feasible. A few days ago, through the courtesy of the Great Northern authorities, I tried one of the new big-boilered Altantics on the 1.30 p.m. Leeds fast express as far as Doncaster, to which point the average speed is within a small fraction of 55 miles an hour with a midway stop at Peterborough. The train may be described as a moderately heavy one, weighing about 280 tons behind the tender. The big engine not only found no difficulty whatever in keeping time with that load at that speed, reaching Doncaster a minute early in spite of an extra signal stop and special delays amounting to about eight minutes in all, but also had to "ease down" at two different points in consequence of being in advance of time, while the speed was deliberately kept under on the down grades. The second stage from Peterborough to Doncaster, 79½ miles, was covered in the quick time of 81 min. 41 sec. start to stop, and could have been done several minutes quicker had the usual high speeds been run down falling gradients. Clearly this was excellent work, and much the same thing was done under my observation by another engine of the same class on the same train on a different day. But was it better than that done by other Great Northern Atlantics with the smaller boilers, 1,444 square feet of heating surface, instead of 2,500 square feet of which 21 have been built? After a careful collation of the respective figures I am inclined to say No; and I may add that my experience has been virtually the same in respect of the big North-Easters. A certain given duty identical as to road, load and speed, was performed by the newer engines practically in the same way as by the older ones. But it would be inaccurate to infer from this that no advantage accrued from their enlargements because in my view the new engines would have made those same runs in just as good time had their loads been increased by 25 or 30 per cent., if not more, whereas the older engines would not. In other words, the new engines have that most valuable possession, a margin of power.

PLANT AT THE MOUNT BISCHOFF TIN MINE.

BEFORE the Institution of Mining and Metallurgy at its last meeting, Mr. Sydney Fawns read a paper on the Mount Bischoff Tin Mine.

The dressing sheds are 1¼ miles from the mine, and transport costs slightly under 1d. per ton. The ore before transport is reduced to a diameter of 2½ in. by rockbreakers. This is hand-fed into a battery, with stamps of the Californian type, 75 heads being in use. The amount crushed by each stamp equals 4·546 tons of ore per twenty-four hours.

The crushed ore after leaving the battery, passes through a careful classification by means of the double-trough-rising current classifiers, the coarse ore being separated from the slimes.

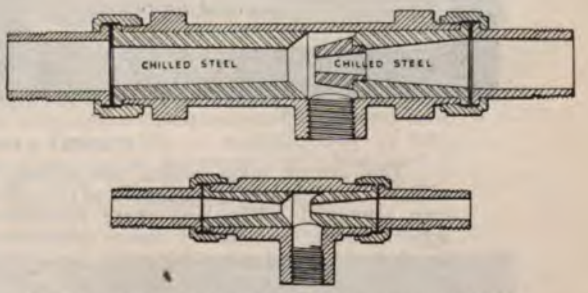


FIG. I. SECTION OF HYDRAULIC JET ELEVATOR.

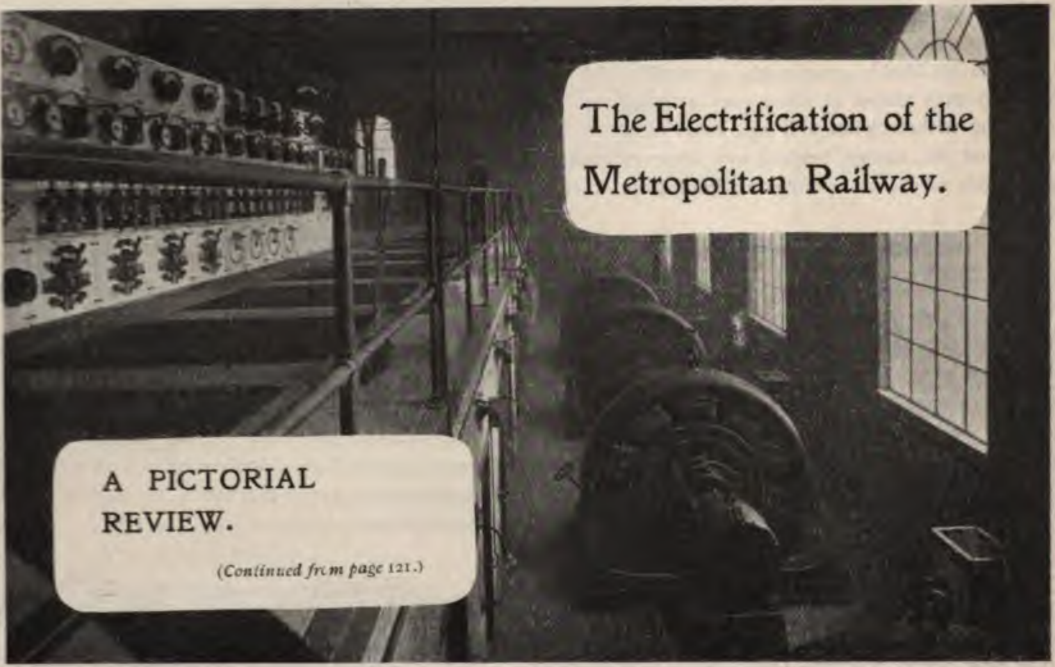
Fig. 1 shows a section of the hydraulic jet elevators which are used extensively in the Bischoff sheds; the jet works silently and requires little attention, the only wearing part being the nipple, which can be replaced in five minutes.

From the classifiers the coarse ore passes into thirty two-compartment Hartz jiggers: those working in coarse sand use sieves of 144 holes to the square inch, and are driven at a speed of 160 strokes of $\frac{5}{16}$ in. to the minute, while those on fine sand have sieves with 196 holes to the square inch, and are driven at 202 ⅛ in. strokes per minute. The ore then passes to thirty-nine rotating tables. The tables are actuated by worm gearing once in 2½ min., the table treating seven hundredweight of slime per hour, and requiring ⅛ h.p. to drive it. Kayser concave buddles are used, working at a speed of 6½ revolutions per minute, and take ¾ h.p. each. The slimes and sands fed on to these buddles are worth 0·25 per cent. of ore. First buddling raises the concentrates to 7 per cent., and re-buddling raises them to 60 per cent. These machines save 4·75 per cent. of the ore recovered from the mine.

The Electrification of the Metropolitan Railway.

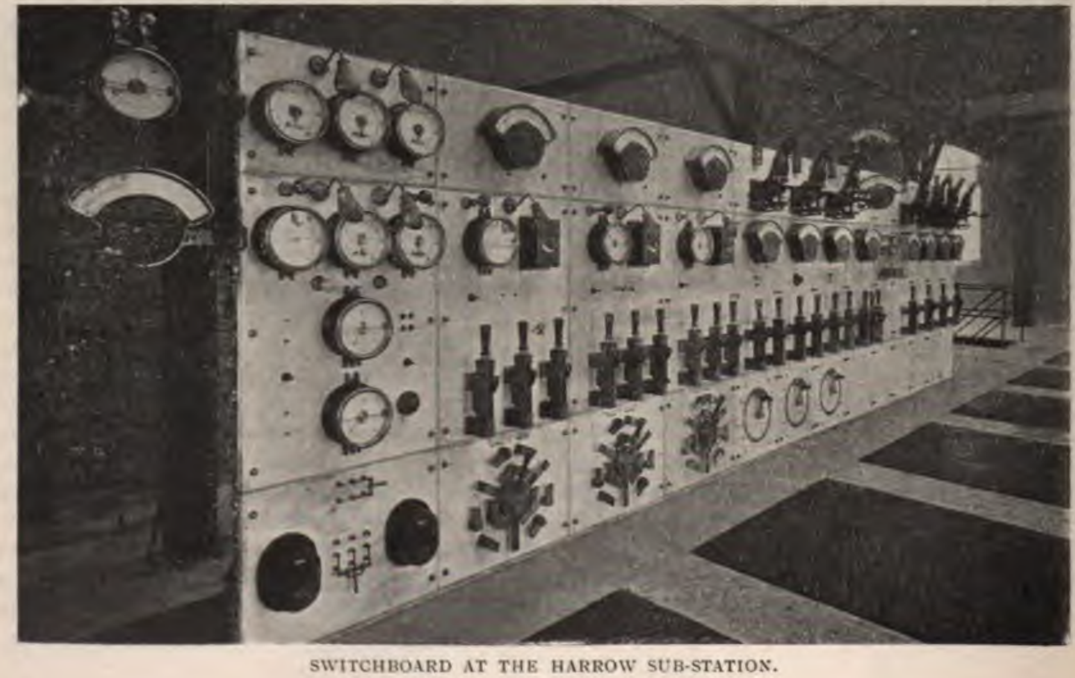
A PICTORIAL REVIEW.

(*Continued from page 121.*)

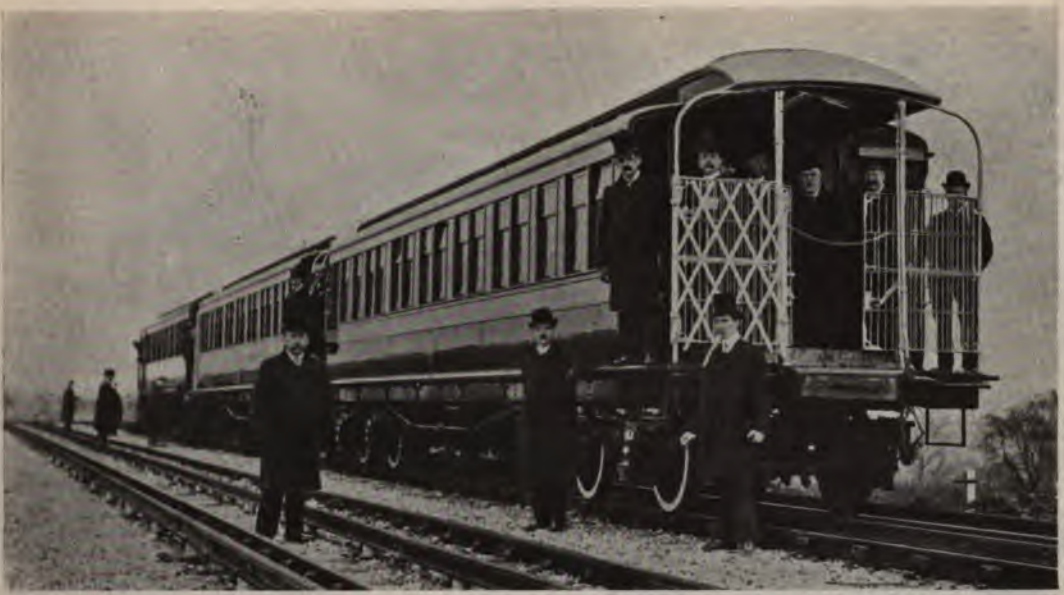


FINCHLEY ROAD SUB-STATION.

The system upon which the railway is operated is the standard one. The 11,000 volt 3-phase current is conducted to the sub-stations by British Insulated and Helsby three-core armoured cables, and there transformed down and changed to direct current at approximately 600 volts by rotary converters. The two sizes of rotary converters employed, 800 kilowatts and 1,200 kilowatts, have respectively 10 and 12 poles, and run at speeds of 400 and 333·3 revolutions per minute. The transformers used in connection with them are of 300-kilowatt and 435-kilowatt capacity per phase, and are of the insulated self-cooling type.

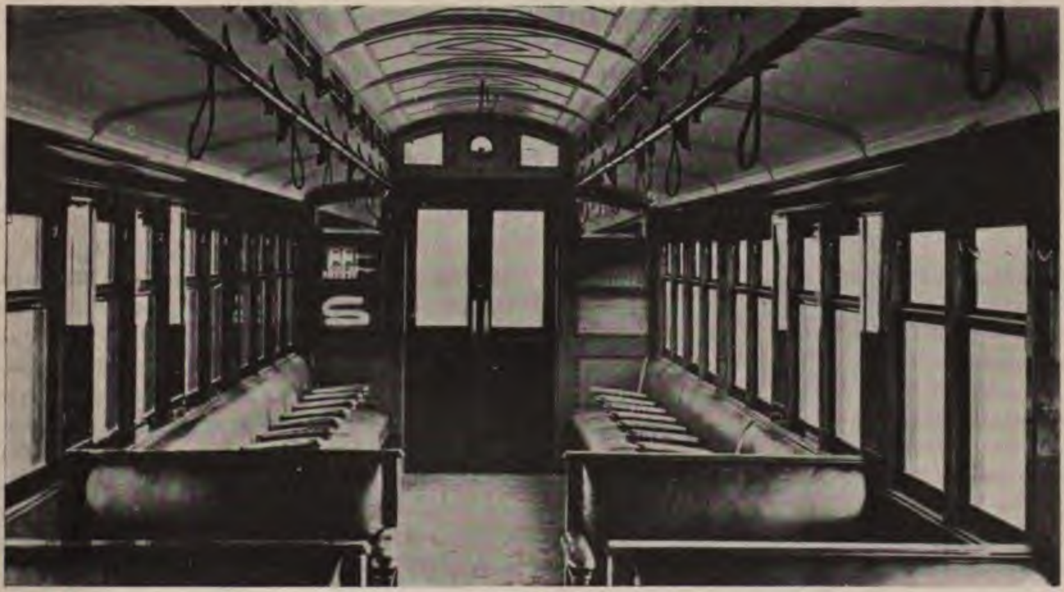


SWITCHBOARD AT THE HARROW SUB-STATION.



ONE OF THE NEW METROPOLITAN TRAINS.

The new rolling stock of the Metropolitan Railway is all of the corridor type, with longitudinal and transverse seats. The cars are 52½ ft. long, and are mounted on two pressed steel four-wheel bogie trucks of English manufacture; their weight is approximately 39 tons. Each motor-car, of which there are two in a train of six coaches, is equipped with four 150-h.p. British Westinghouse railway motors, one for each axel of the truck; there will, therefore, be the unusual amount of 1,200 h.p. available for propelling each train.



CAR INTERIOR.

Sliding doors are fitted at the ends of the cars, and patent swing gates give ready and ample access to the station platforms. All the rolling stock has been built at Birmingham and Manchester by the Metropolitan Amalgamated Railway Carriage and Wagon Company, Ltd., under the immediate supervision of the Railway Company's carriage and wagon superintendent, the entire electrical equipment being designed by the British Westinghouse Company.

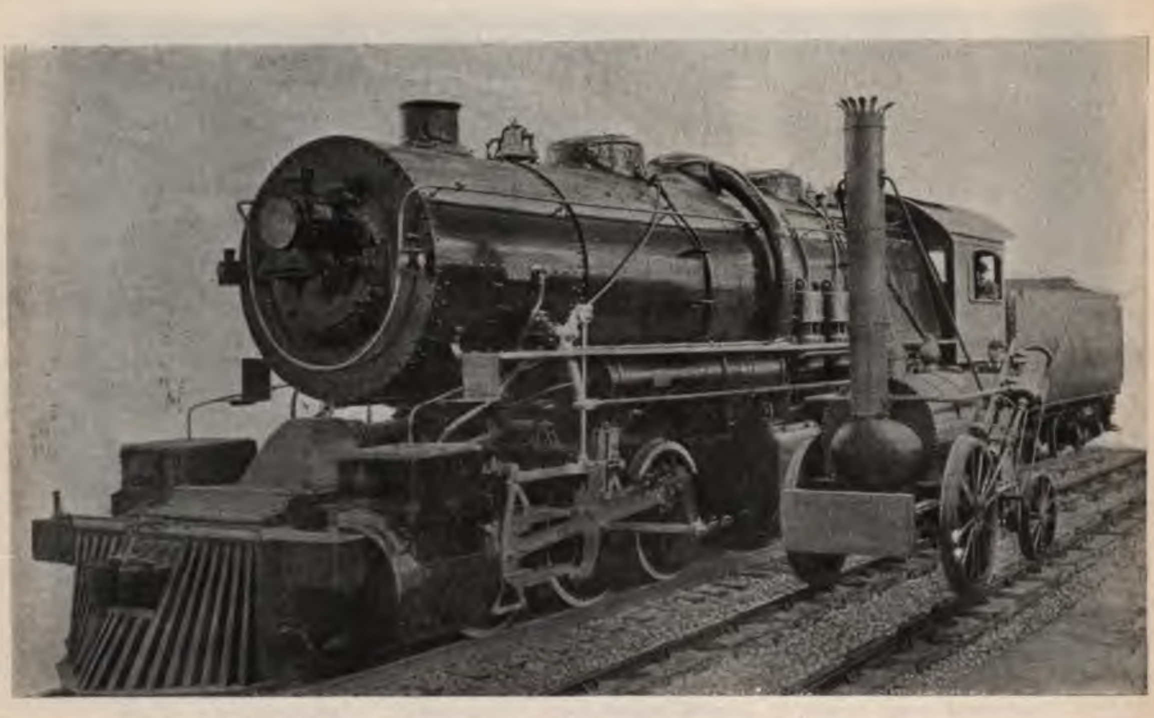
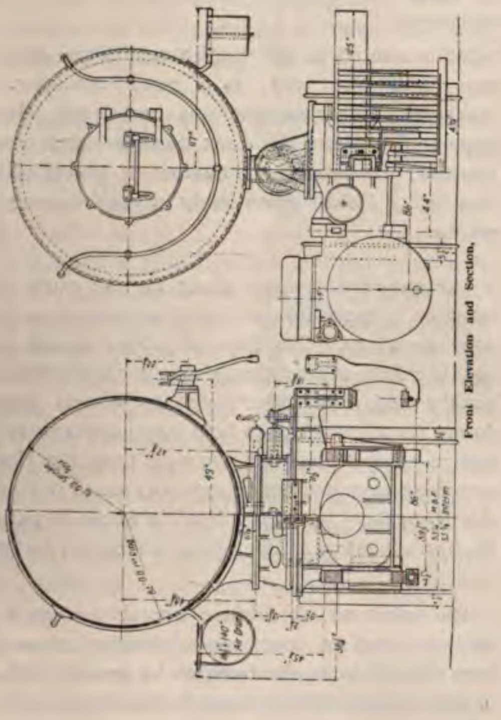


FIG. 1. MALLET ARTICULATED COMPOUND LOCOMOTIVE BY THE AMERICAN LOCOMOTIVE COMPANY, CONTRASTED WITH STEPHENSON'S "ROCKET."

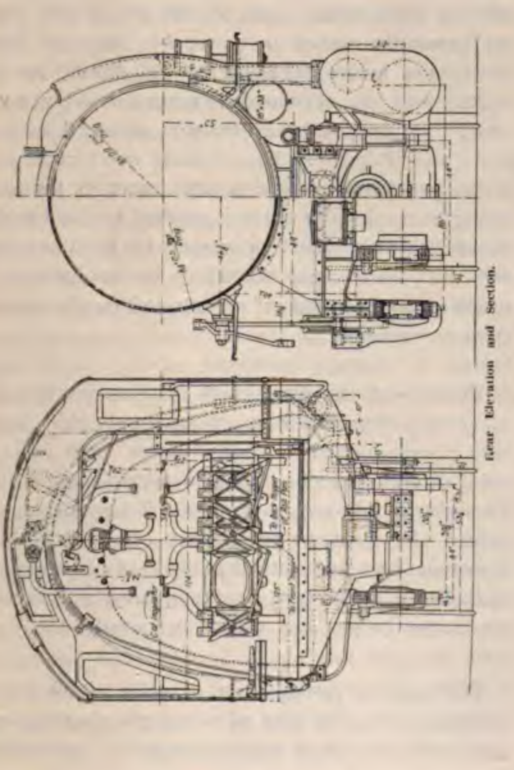
MALLET ARTICULATED COMPOUND LOCOMOTIVE (B. AND O. R. R.)

BY THE AMERICAN LOCOMOTIVE COMPANY.

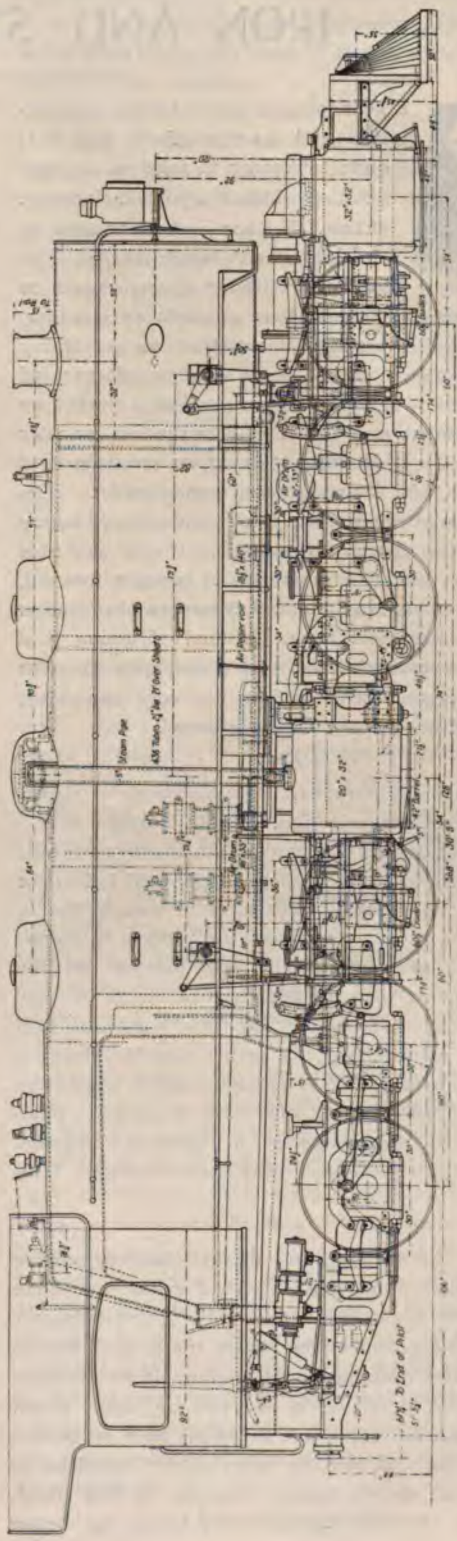
THIS powerful engine exerts a tractive force of over 71,000 lb. working compound and over 86,000 lb. working simple, and is designed for use in heavy pushing service on mountain grades. The Mallet system of compounding is used for steam and power distribution. While all four cylinders are outside the frame, the low and high-pressure cylinders are entirely independent of each other in respect to their movement and action on the wheels. The two high-pressure cylinders form a complete engine connected to and driving six drivers in the ordinary way. Ahead of this engine is another, also having six drivers driven by the low-pressure cylinders. This forward engine has a separate frame, connected by a hinged joint at the back to the frame to the rear engine. There are two complete sets of valve gears, cross-heads, rods, and other parts directly concerned with the engines. The steam, which is at 235 lb. pressure, after being expanded in the high-pressure cylinders, is exhausted into a receiver consisting of a large pipe having a flexible connection and reaching between the two cylinders castings, from which it is admitted into the low-pressure cylinders for further work. The Mallet system of compounding is for use only on heavy slow-speed engines where, because of the distribution of power at the driving wheels, it has proved to be very successful. Fig. 1 shows this huge locomotive in comparison with Stephenson's "Rocket." For the accompanying illustrations and the above particulars we are indebted to the Railway and Engineering Review, of Chicago. This engine was one of the most notable exhibits at the St. Louis Exhibition.



Front Elevation and Section.



Rear Elevation and Section.



General Elevation.

DETAILS OF MALLET ARTICULATED COMPOUND LOCOMOTIVE.

IRON AND STEEL NOTES.

We hear so much about foreign competition and its dire effects that it is quite refreshing to take up a paper like that which Mr. Jos. H. Harrison, M.Inst.C.E., has just contributed to the Cleveland Institution of Engineers. Without a single word on the fiscal question,' the author proceeds to consider, from a practical standpoint, whether we are trying to meet foreign competition in the manufacture of iron and steel. The paper is more or less in the nature of an indictment, and the sting is in the tail, for after an impartial consideration of what we are doing and ought to do, Mr. Harrison says emphatically: "The conservatism of the iron and steel trade of this country is the greatest barrier to progress. If any new idea likely to be useful, if workable, is brought forward, whether home-made or imported, it meets with objection in every conceivable form. Instead of giving it a lift along, everyone's foot goes down upon it. The inventive power for objections to any new idea, especially if not imported, is enormous."

The paper may very well be summed up as a plea for more perfect organisation. As Mr. Harrison says—You may put down the very finest machinery and plant of every kind to produce steel cheaply, and fail to get the results hoped for. The secret of success lies in so arranging these as to make the process of manufacture continuous from the raw materal to the finished product with the least possible waste of time, and with the least possible handling, combined with systematic management. I gather that Mr. Harrison would have us approach American ideals in a selective and discriminating spirit, and when it comes to practical reforms, he advocates in pungent language that the British engineer shall have the job—Why not, indeed?

There is, he says, no lack of first-class engineering skill in most of our iron and steel works, but there is very little opportunity to use it. The ironmaster will not venture out of the beaten track, until he has seen the same thing he wants, working under the same conditions at other works for two or three years. When at last he wakes up and finds he is all behind the times, he flies into the arms of the American or German, and spends money wholesale on new plant, whilst the British engineer, who knows far better what is wanted to suit British conditions, and could save half the cost, is a mere spectator. So much for precepts and maxims. Mr. Harrison happily does more than ask questions and proclaim theories; he provides a number of practical hints, from which I shall quote freely in the following paragraphs.

The author first casts about for the cause of our inability to make iron and steel as cheaply as can be done elsewhere. The item of labour is one cause; not that there is a deficiency of it nor is the individual quality bad, but collectively the British workmen do not do all they can to help their employer to meet foreign competition. At the same time, Mr. Harrison urges engineers and metallurgists to see to it that they are doing *their* part to utilise the forces of nature to the best advantage. He begins with the raw materials.

The ironstone is within a very few miles of their furnaces, and in some cases actually comes down from the mines to the furnaces by gravity; the size of the lumps in which it comes to the furnaces is limited only by the weight a man can lift into a tub. Why not break the stones to reasonable size, say about 8 in. cubes before calcining? This should be done at the mines, and if properly arranged would cost very little, compared with the benefits obtained in regularity and efficiency. The breaking won't make much small, but there may be a little more in the kilns, owing to the greater surface exposed to the rubbing, but it is surface which is wanted for good calcining, and a little more small ore will do far less harm in the furnace than the amount of raw and partly calcined stone now going in.

Then about the lime—it is an open question as to calcining it with the stone, or separately, but in any case it seems wrong to charge it raw, both from the point of view of economy and regularity of condition. This also should not be unloaded if larger than 6 in. cubes. It is not the furnaceman's business to break limestone, and this method is obviously irregular and inefficient. A machine at the quarry will break it for far less money, and will do it honestly, too.

The coke is perhaps not so good chemically, or mechanically, as it used to be, and by putting down coke ovens at blast furnaces there is less handling and breakage, and consequently the coke is in better condition when it gets into the furnace. Some firms do not yet see the benefit of bringing their ovens to the furnaces, but the experience of those who have done so should be convincing.

With regard to getting the materials into the furnace, it seems to Mr. Harrison that is no use putting skip charging arrangements to our furnaces, so long as they are not worked beyond 150 to 200 tons each per day, and it has yet to be proved in this country that to scrap such furnace plants and put up entirely new ones to make 300 to 400 tons per day is the right way to make a better profit. If mechanical charging is good for the 300-ton furnace, it is good for the 150-ton furnace, provided the system is made to suit the conditions. He believes this is the opinion of a good many British ironmasters, but they do not appear to be bold enough to take the job in hand, and do it. They have only to say they want it done, and there are plenty of firms in this country who would undertake it and make a success of it. If the British engineer seriously asked to be allowed to spend one half of the money per furnace we see being spent around us under foreign supervision, he would be met with a flat refusal, if nothing worse. It is quite true a vast amount of money requires to be spent on plant, to get it in line to meet foreign competition, but the British engineer is quite equal to the occasion, if he is given the chance, and knows the best how to lay the money out to make profits. There is such a thing as "paying too much for the whistle."

Coming back to mechanical charging, he says it is a good investment to spend £3,000 on plant, to save one man on each of the three shifts. Five per cent. interest on this sum about shows the wages saved, but this is not nearly all the gain. The enormous use of labour saving devices in America is not with a view to saving wages alone, but to increasing output. A further saving by mechanical charging is the gas wasted at present each time the bell is lowered.

With regard to the tapping hole gun, this is used at only one or two works in this district, and at very few outside, so far as this country is concerned. Some have discarded it as unusable, because the men would not use it. But is this sufficient excuse for discarding a tool which enables the hole to be closed, practically without the blast off? The gun will stop the hole, whether all the metal is to be run out or not, and it is only necessary to check the blast for half a minute, at the most, just enough to get in the first clay plug, then the blast put full on again gives the gun something to ram the following plugs up against. This must be better than taking the blast off altogether for anything from 5 to 20 minutes.

The pig-casting machine has made no headway here, because of the chilling effect of the moulds, and the altering of the crystalline condition of the fracture. It would not, however, be either difficult or expensive to try some arrangement for moulding the pig-beds by a machine. This would save a good deal of manual work, which, to say the least, is monotonous, and there would be some wages saved and the work done in less time. Then there is the pig-breaking machine. This is perfectly successful in reducing the cost and getting rid of a troublesome class of labour. It is not used at all on Cleveland iron, which goes away in whole pigs, but the author fails to see why it should not be a saver on this iron as well as on Hematite, which goes away in half pigs. The machine will do the work, and he believes at less cost than by hand labour, and scrap will be saved.

Furnace makes have increased of late years, but the average on Cleveland iron is still under 800 tons per week. But there is no reason why this average should not be increased at least 50 per cent. without scrapping the existing plant. Some of the local firms have shown this can be done, and there is no mystery about it. It is only a question of increasing the quantity of hot blast and materials brought together in the furnace in a given time, combined with intelligent practical management. To do this, more boiler blowing and stove power is required on the one hand, and more calcining, bunkering, and slagging power on the other, and the whole process carried out under systematic supervision. In many cases there is no need to go beyond the cost of installing the additional plant required to augment that existing, but in others the blowing engine would be found unable to work at either increased speed or pressure, owing to their light construction. In cases where an old furnace plant has been run without intelligent practical management, for say 10 or 15 years, and has been allowed to fall far below its neighbours in efficiency, Mr. Harrison does not dispute it may be the best plan to demolish it, lock, stock, and barrel, and build an entirely new plant in its place, but thinks that so long as the existing plant is in good condition, it is better to add to it, and make say 300 to 400 tons per day in two furnaces of moderate capacity, rather than in one of large capacity.

(*To be continued.*)

New Coal-Screening Plant at Kilnhurst Colliery

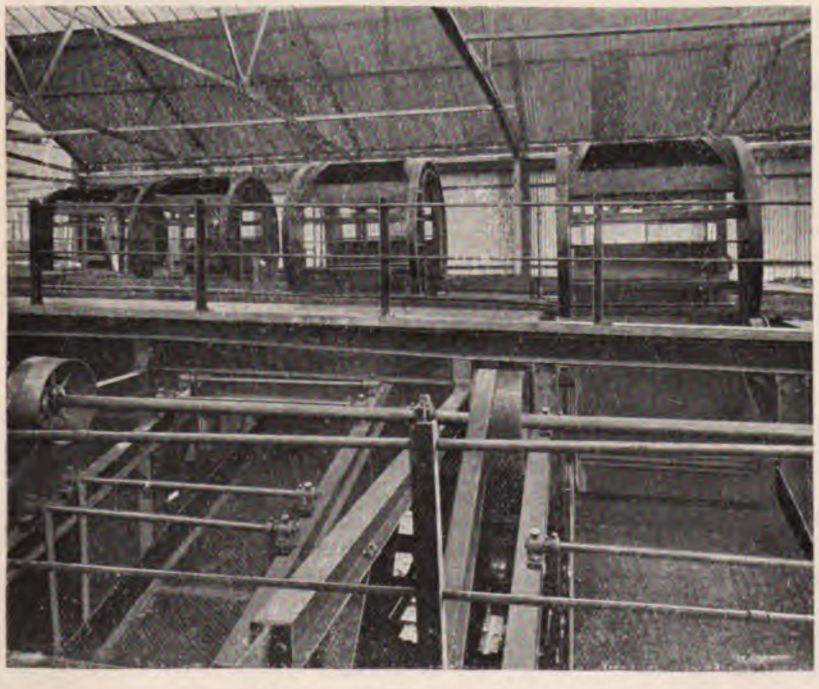
BY MESSRS. GRAHAM, MORTON & CO., LTD., LEEDS.

Capacity, 3,000 tons per day.

THE plant which is illustrated in this and the following pages has been carried out by Messrs. Graham, Morton and Co., Ltd., of Leeds, in connection with the Kilnhurst Colliery of Messrs. J. and J. Charlesworth, near Sheffield. It consists of three inclined tub-gantries, leading from two pit shafts with a screening and picking-house between.

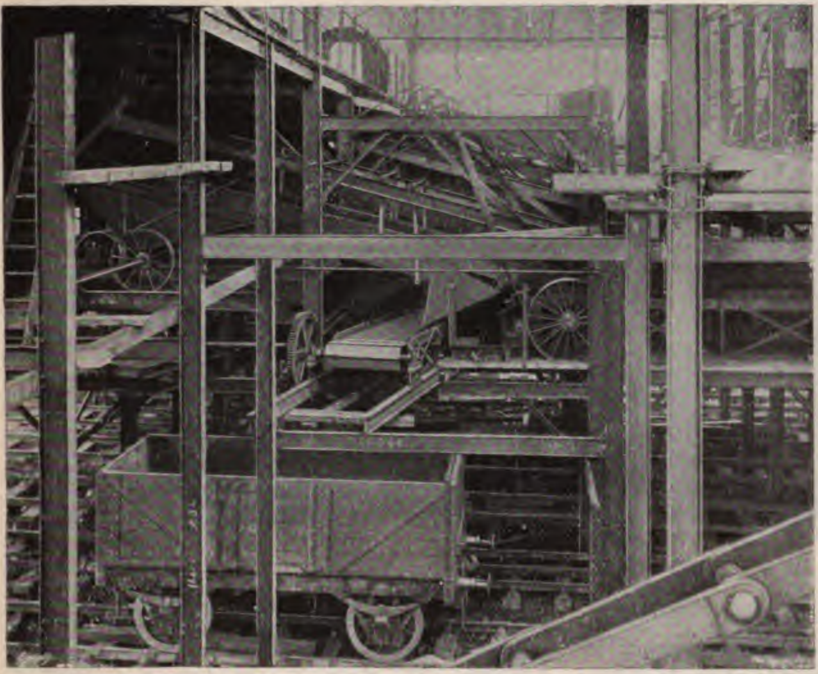
Gantry No. 1 is built of two floors, so as to deal with the tubs from the double-decked cages at the high-level pit simultaneously. The tubs, on leaving the two decks of the cages, run down by gravity to the bottom of a steep sloping gantry, and are drawn up by means of creepers which are formed of 12-in. links, securely bolted together so as to form a continuous chain, with rollers pitched every 3 ft., the attachment for engaging with the tubs being pitched 6 ft. apart. At the top they converge on one plane, where they pass over a weighing machine, which automatically records the weight of each tub. They then fall by gravitation to one of four tipplers, where their contents are discharged automatically upon revolving rollers which rotate the tippler. As the tippler turns round an automatic catch comes into action, with levers, thereby preventing the tubs from falling out. The next full tub coming along pushes the empty tub out of the tippler. The empties continue their course through the screening-house and return to the high-level pit by means of gantry No. 2, which is solely used for the return empties, and is provided with two floors to suit the double-decked cages.

Gantry No. 3 deals with the tubs from the low-level pit, having the full tubs brought the one side and the empties returned by creepers similar to those on No. 1 gantry. The tubs are directed to any of the four tipplers, and to either of the return gantries by means of an elaborate system of points and crossings operated either by hand or foot. This portion of the plant presented considerable difficulty which called for careful study, as there are two classes of tubs in use at this colliery, each having a different wheel-gauge.



TIPPLERS AND JIGGING SCREENS.

After the load has been discharged, the sides of the tipplers engage with suitable locking gear, which keep them in position until fresh tubs have run in. The contents of the tubs are discharged down shoots which feed on to a fluted roller which distributes the coal evenly over the full width of the perforated jigging screens through which it is sized. The jigging screens are arranged immediately underneath the tipplers. Two are placed in position for dealing with hard coal,



DISCHARGING END OF THE PICKING BELT.

one negotiates soft coal, and the other gas coal. Each screen is 26 ft. long, by 5 ft. 6 in. wide. On the underside of each main screen there is a secondary screen, with perforated plates, their object being to separate the nuts and peas into distinctive hoppers. The screenings are collected by means of suitable receiving hoppers in position on the underside of the secondary screens, working on the self-emptying principle.

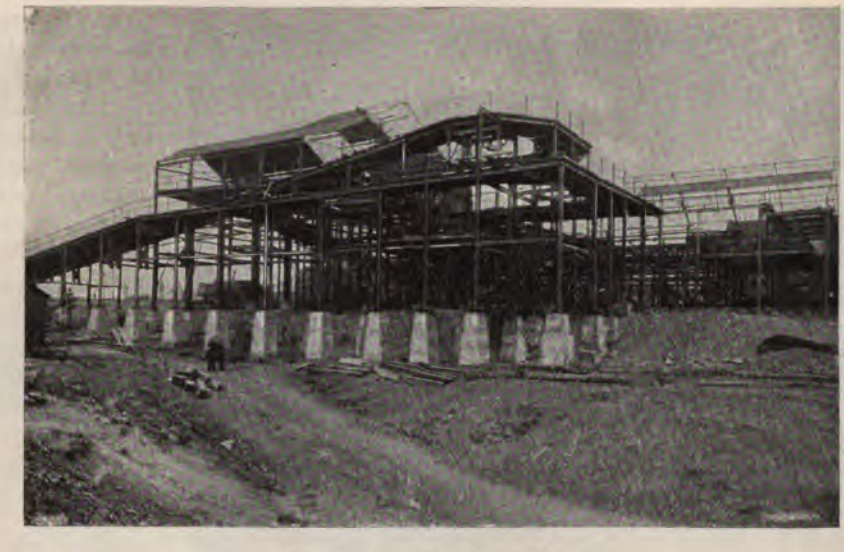
The coal passes through the first set of the jigging screens, then over the second screens hung beneath the first, where it is again screened. It is subsequently delivered by shoots, the slack on to a steel-belt conveyor, which carries it direct to the wagons, and the remainder or smallest of the coal into a special push-plate conveyor, which takes it to a revolving screen where it is again riddled, the peas being discharged into trucks and the smudge either into trucks or into another push-plate conveyor, which delivers it into an elevator. The latter, in turn, raises it to the tub gantries, whence it can be taken for firing the colliery company's boilers, etc.

The hard coal and the soft coal jigging screens are provided with two pairs of eccentrics, and straps 5-in. stroke. The gas coal screen is driven by means of a single pair of eccentrics, the eccentric rods are formed of 3-in. by ⅜-in. flat steel, forged with suitable jaws for attaching to the screens, and they are bolted to the eccentric straps at the other end. The shafts for driving the screens are of 4½ in. diameter, and on each shaft is keyed a 3-in. diameter cast-iron flywheel weighing 5 cwt., and provided with the necessary pedestals, collars, etc. The angle of the screens is 15 deg., and the rate of work is 100 jigs per minute.

The conveyors are of the push-plate type. Their dimensions are 42 ft. 6 in. between centres, and their width 30 in. and 24 in. respectively. One is for collecting the smudge and the riddlings from the hoppers, situated on the underside of the jigging screen, and the other for delivering the small coal into the revolving screen. Each conveyor is built up of a steel trough, with steel channels, flanges and bottom plates, the return chains being supported on a lattice-braced framework, built up from the channel runners.

Each conveyor is provided with two strands of 6 in. pitch chain of thin and thick links bolted together. To the thick links are attached the push-plates, arranged at intervals of 2 ft.; these are a ¼ in. thick, and supplied with skidder bars formed of 3-in. by ⅜-in. angles, the angle runners on the conveyors being provided with 2½-in. by $\frac{7}{16}$in. hard wood strips. In addition to the push-plate conveyors described, there is provided another, 41 ft. between centres, 12 in. broad, and built up in a similar manner to those which collect the smudge from the hoppers, and delivers the small coal into the revolving screens. This third conveyor, however, has only one strand of chain. It is at this point in its history that the coal is delivered into a revolving screen, 5 ft. 6 in. in diameter, by 11 ft. long, with a capacity of screening about 40 tons per hour of small coal.

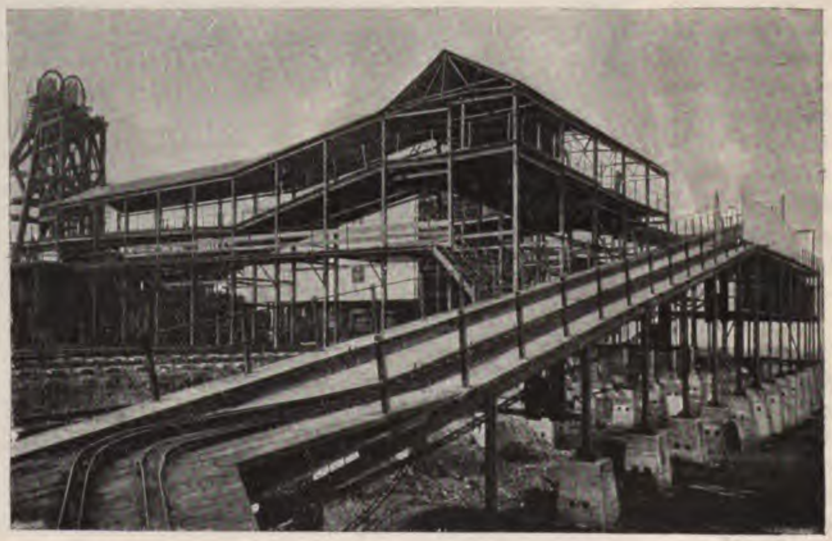
The gearing necessary for driving the whole of the plant consists of one main driving shaft, about 25 ft. long and 5½ in. diameter. From this shaft are tapered the various drives to the picking belts, jigging screens, scraper conveyor, revolving screens, and the raising and lowering gear for the lowering arms on the ends of the picking belts. The drive to the lowering arm is



GENERAL VIEW OF STAGING.

effected by means of a $3\frac{1}{2}$-in. steel shaft, which runs the whole length of the screening-house. It is supported from the stanchions forming the side of the house by means of cast-iron brackets, the centres of which are 1 ft. 9 in. Each set of lowering gear is operated by means of 18 in. diameter wrought-iron pulleys, 18-in. face, which drive similar pulleys by open and cross belts.

The whole of the machinery is driven by a powerful horizontal steam engine, from which the main driving shaft is driven by means of double leather belting. It may afford a good idea of the magnitude of the plant which was constructed in the short space of two months, if we state that there are nine railway tracks passing through the screening-house, two of these being through roads. The complete plant covers an area of 21,300 square feet. It is supported on 193 stanchions, while the total weight of the structure, independent of all machinery, is 300 tons. There are 22,876 lineal feet of 9-in. by 3-in. planking used in the flooring, and 20,180 superficial feet of corrugated sheeting used on the roof and sides. The plant dispenses with the employment a large number of hands to push the tubs about and to scrape the coal down the screens, etc.



EMPTY TUB DISCHARGE RAMP.

SOME IMPRESSIONS OF AMERICAN WORKSHOPS.

By A. J. GIMSON.

WHEN in America the writer visited sixteen engineering workshops situated in cities far distant from one another, and comprising works for the manufacture of steam-engines, pumping machinery, shafting and pulleys, machine tools, elevators, and valves. Any ideas that may be here set down are of a very general character, for it was not the author's intention to inspect or investigate any special class of work.

The works visited ranged from factories at least two generations old, where generally a considerable variety of work was undertaken, to modern workshops of only a few years growth, where a special class of machine was alone manufactured. The very best of these workshops, with possibly one exception, could be matched in equipment and in general methods of carrying out work by single works in this country. Some of them were in no way in advance of ordinary practice here.

In general, however, the organisation of an engineer's workshop in America struck the author as superior to that in similar works in England, whilst in some the organisation was in every detail admirably thought out and administered.

SPECIALISTS IN MANUFACTURE.

In a modern business an American begins to make one particular machine or particular kind of machine. His whole energy is, in the first instance, concentrated upon making this machine superior to anything at the time upon the market. More than with us, he thinks that natural ability is aided by the best scientific knowledge in the design of the machine to be produced.

A feature of the engineering industry that impressed the author was the close intercommunication of technical institutes and manufacturing workshops, of professors and manufacturers, and the presence, in minor positions of authority, of young men who had passed through a complete course of technical instruction. The American employer gives one the impression of being a firm believer in the merit of the machine he is manufacturing. Doubt is eliminated from his mind, and he can enter whole-heartedly into the processes of manufacturing his particular article without a fear that it may not meet the needs of his customer. His confidence is based on a very complete knowledge of his subject, and not upon an over-exalted belief in his own special ability. When the actual making of the machine designed comes to be undertaken, it is essential that accuracy and economy of production shall be attained.

Methods were observed for obtaining accurate machine work, and methods of testing the accuracy of machines as they were being put together, which were admirable in their approach towards perfection: No detail is too trivial to be well thought out, and the tests are such that their object is attained without needing any considerable expenditure of time on the part of the workman. Although he does not remember having seen any workmen exerting themselves more than is usual in shops here, the author is convinced more work is obtained from them through the close study of economies by the staff in the drawing and allied offices.

THE SUBDIVISION OF LABOUR.

An American employer will see that his workmen have no reason to use their time for any purpose in which they are not skilled. His foremen will do no clerks' work. His machine men will not be grinders of tools nor designers and constructors of methods for holding and machining the work. A machine minder's business is to keep his machine moving and his tools cutting every minute of the day that is possible. It is relegated to others to design, to grind, to fetch and carry his tools, to prepare chucks, jigs and everything requisite, so that they may be ready to the workman's hand at the time they are wanted; and to his foreman is relegated the chief duty of seeing that the work is quickly and correctly done. It would be instructive to some here to know what proportion of the time of a factory's running is used by any given machine in actually performing the work it is designed to do.

The writer has seen a works where every separate job for every machine is ordered and arranged from the office staff, where every detail in the process of its machining is settled, and the number of minutes each process must occupy is displayed before the article reaches the workman's hands. In such a works a liberal bonus is paid for a saving in time, and rigorous methods are in force against those who fail to carry out the work in the stipulated time. Such methods may appear harsh, but he believes that in practice they are not so, for they are the result of accurate experience gained by an expert staff, and they recognise the enormous difference in industry and ability, that there is between different workmen.

ENGLISH AND AMERICAN WORKSHOP PRACTICE.

The able man is allowed full play for his ability, and is rewarded by a very great increase in money earned over his slower or less industrious neighbour. In the same way, by card processes, by clocks with dials divided into tenths and hundredths, are minutes saved which a workman uses in calculating his time and which a clerk wastes in complicated addition and multiplication of figures. Persistent energy and patience have achieved remarkable results in the organisation of cheap production in some of these workshops. This is the chief difference, stated in general terms, between English and American workshop practice. In this country they are somewhat wasteful of the workmen's time; in America they are careful of it to a remarkable extent. It follows that if American engineers compete successfully against English engineers, it will be, in the author's opinion, because the organisers of their businesses know their work, and carry it out better than do the organisers of businesses here. Their workmen are in no way superior but their skill and ability are used to better advantage.

In matters of design, as distinct entirely from methods of manufacture, the writer did not note great differences between American and English practice. On both sides of the Atlantic the same problems are attacked on similar lines; in details they differ, but not in principles. It would seem that there is much to be learnt from each other in these things, and that the more friendly rivalry there is between the engineers of the two nations, the better will it be for the engineering industry of the world.

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* Paper read before the Institution of Mechanical Engineers.

WATERWORKS PUMPING ENGINES IN THE STATES.

At the meeting of the Institute of Mechanical Engineers, held on Friday last, Mr. John Barr read a paper on this subject, of which the following is an abstract :—

The pumping stations described are Schenectady, Cincinnati, Philadelphia, Pittsburg, Chicago, St. Louis, Desmoines, Minneapolis, Winnipeg, Toronto, London (Ontario), and Boston. The author sums up the result of his observations as follows :—

The type of high-duty waterworks pumping-engine in the United States is generally that of rotary vertical triple-expansion ; this is undoubtedly the most modern type, gives best duty, and seems to be the favourite.

The steam-valves are Corliss in the high-pressure cylinder, usually Corliss in the intermediate cylinders, and poppet in the low-pressure cylinder.

Piston speed is usually about 200 ft. per minute, sometimes a little higher.

Duty under test-run varies from 140 to 160 millions of ft.-lb. per 1,000 lb. of steam, for engines having a daily capacity of from 10 to 15 millions of gallons pumped into mains against a pressure of about 100 lb. per square inch. Pumps work quite well with suction under a head of pressure, air-vessels of ample capacity and means of keeping them charged with air being provided.

Air-vessels of ample size are provided both on suction and delivery pipes. It is a common practice to have an air-vessel on top of each delivery-valve, the three air-vessels being equalised by a connecting pipe.

Pump-valves are of the multiple type of rubber or vulcanite backed by a brass or phosphor-bronze spring. Valves are about 4 in. diameter, and are very frequently set in cages placed in a strong plate in valve casing.

Centre crank-pin of large pumping-engines has one end in square block carefully fitted into slot in web of crank on one side to allow "accommodation."

Journals are almost invariably lined with "Babbett" metal.

A heater is frequently inserted in exhaust-pipe between the low-pressure cylinder and condensers. The rise in temperature thus gained by feed-water cannot be great, but is considered worth getting.

Many of these large engines are splendid examples of mechanical engineering, being smooth working, efficient, and well-finished machines.

At Minneapolis there has just been erected and set to work two sets of Holby vertical triple-expansion surface-condensing pumping engines.

Fig. 1 shows a screening arrangement at the intake from the River Mississippi in connection with the Minneapolis waterworks. The square frame at top revolves, and the screens, in the form of an endless band of rectangular sections, pass over it as they reach the top. The screens travel slowly, the water-jets spraying and washing all the time, keeping screens clean.

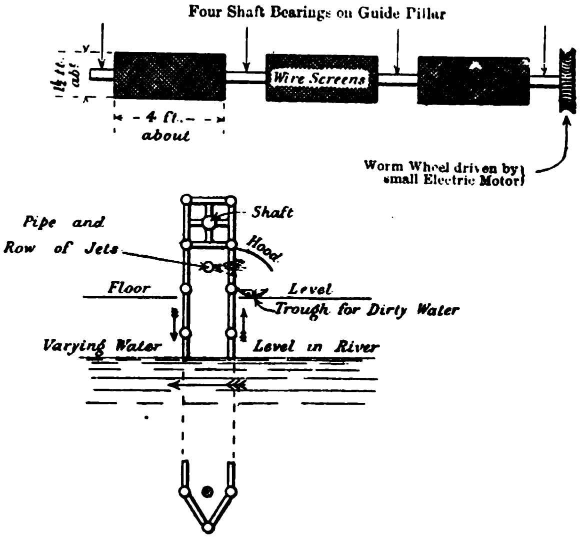


FIG. I. REVOLVING SCREENS AT INTAKE FROM RIVER MISSISSIPPI.

In Great Britain the duty of pumping-engines is usually expressed in ft.-lb. of water lifted per 12 lb. of best Welsh coal. In the United States and Canada this duty is given as per 1,000 lb. of dry steam. In the United States the gallon employed is the "United States gallon," equal to five-sixths of the Imperial gallon. In Canada the Imperial gallon seems to be usually employed.

At the sixth ordinary general meeting of the Liverpool Engineering Society, held on Wednesday last, Mr. F. W. Steele submitted a paper entitled "Design and Work of Pressing, Stamping, Forging, and Similar Machinery." The presentation of the "Derby" gold medal and the society's premium awarded respectively to Mr. Louis J. Hunt, Assoc.M.Inst.C.E. A.M.I.E.E., and Mr. H. S. Meyer, M.Inst.I.E.E., was made at the same meeting.

ELECTRIC HEATING.

A paper on this subject was read before the Manchester Students' Section of the Institution of Electrical Engineers by Mr. Albert E. Jepson, on the 13th inst. The following is an abstract of the paper :—

The author points out that one of the chief arguments against the use of electricity for heating purposes is the great cost for actual working expenses. Before electricity can be expected to supersede coal for this purpose, it will have to be sold at slightly under 1d. per b.o.t. unit. Early types of heaters were generally composed of platinum wire resistances, until attention was afterwards directed to the use of enamels of a nature similar to that used on enamelled iron ware. The enamel proper consists of flint meal (which is composed of quartz and silicates of iron and aluminium), also tin oxide, saltpetre, ammonium-carbonate, lead sulphate, magnesium sulphate, potassium carbonate, borax, and sometimes gypsum and arsenic. These are mixed in varying proportions, very carefully selected, as too much of one chemical will make the enamel crack off, and too much of another will make the enamel melt too soon, or take too much heat to fuse on to the ground enamel while in the furnace.

One type of heating-unit made under Byng and other patents has the resistance wire crimped in a machine and then formed into the required shape, This is a wire crimped and curled just as it would be applied upon the ground enamel and after being covered with the surface enamel, connection is made to the resistance by means of the coppers attached to the ends.

Generally, cast or sheet iron is used as the base. In another type of heater for water utensils, made under Prometheus patents, very thin platinum foil of the desired shape and resistance is laid on the enamel surface and fired at a high temperature. Under another patent is also made a type of heater which is composed of strips of mica 4-1000ths of an inch thick, upon which is painted an extremely thin film of metal, generally gold or platinum. The film is sometimes only 1-4,500ths of a millimetre thick, and is quite transparent. The metals, in the form of powders, are mixed with a flux and painted on the mica and then fired in a furnace.

These films can be produced at 100,000 ohms resistance, and are usually made to consume not more than 70 watts, this being equivalent to a temperature of 450 deg. C. The films can, of course, be painted as thin and narrow as desired. When a strip of mica has a film deposited on one side, it is covered with another strip of mica and secured by a thin metal frame, which has a very small capacity for heat. When used for warming a room, these units are fixed in a metal framework which connects them in a parallel so that if one breaks down the others will continue to give out heat. In this system enamel and porcelain is used up to 250 deg. C., but beyond this temperature mica is used as the insulating base.

DIFFERENT SYSTEMS DESCRIBED.

In the Parvillée and Le Roy systems, another direction is taken altogether in the application of the heating effect. The heating units are composed of a mixture of silicates and metal, cast into bars, or of bars of agglomerate silicon. These bars of agglomerate silicon are enclosed in glass bulbs and the air exhausted. These are then fixed in frames and used as radiators or heaters. In the case of the bars of metallo-ceramic composition of the Parvillée system they can be made of any desired resistance within reasonable limits, and then brazed on to brass springs, which take up the expansion of the bars, and to which connection can be made. This metallo-ceramic compound can be made into any shape desired, which enables it to be used for many electric heating purposes.

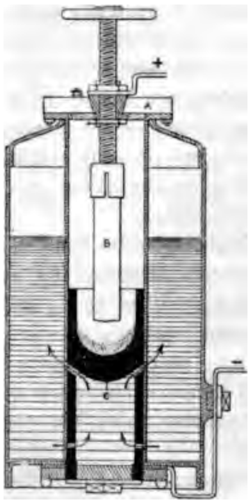


FIG. 1. SECTION OF ELECTRIC HEATER ON OUGRIMOFF SYSTEM.

In the Schindler-Jenny system the resistance, composed of wire, foil, or tape, is formed into the required shape and covered with porcelain clay, after which it is fired in a furnace, and then round the whole is cast a metallic shell of aluminium, copper, bronze, or any other suitable metal, which makes the whole a mechanically strong homogeneous mass. The units are made into various shapes, flat, with or without ribs on either or both sides, but for some types of radiators they are cast into a circular shape with ribs on the circumference, connection to the resistance being made by three contact pins projecting through three holes in the shell.

CARBON USED AS RESISTANCE MATERIAL.

In many instances, carbon is used as the resistance material as in curling irons, in which a thin pencil of carbon consuming 25 watts, is placed in the circular tongue, which is usually made of aluminium. A pencil of carbon is also used in one of the latest types of radiators, which consist of lamps about 10 in. long and 2½ in. in diameter. The contained carbon filament is about 1-16th in. in diameter, and about 13 in. long, being bent in the middle to form a single loop, each lamp consuming about 250 to 300 watts, with usually four lamps in each radiator.

Furnaces of the Borchers type also use a carbon pencil as the resistance. A small pencil of carbon 2 in. long and ⅛ in. diameter with conical ends is held in position by two very large carbon rods having conical recesses in the end of each. When a current is passed through the combination, the pencil of carbon is elevated to a white heat, fusing the mass of material which has previously been spread round it.

The following table is interesting as showing the efficiency of various sources of light :—

Efficiency of Various Sources of Light.

Source of Light.	Total Consumption of Energy in Watts required to produce a light of one Candle.	Ratio of Luminous to total Radiation, or Luminous Efficiency.
Candle	86 watts	2 to 3 per cent.
Oil lamp	57 ,,	3 ,,
Petroleum lamp ...	42·8 ,,	3 ,,
Argand gas lamp ...	68·8 ,,	4 ,,
Electric glow lamp ...	3½ ,,	3 to 7 ,,
Electric arc	0·8 ,,	5 to 15 ,,
Magnesium wire ...	......	15 ,,
Electric discharge in rarefied gases ...	......	33 ,,

One of the most useful sources of heat is the electric arc, which is used extensively in many metallurgical and chemical processes. It is also used in a few domestic and similar appliances. Professor Ougrimoff, of Moscow, has designed a water heater of 98 per cent. efficiency, in which he uses the electric arc to splendid advantage (fig. 1). This heater, which can be used for many chemical processes and distilleries, consists of a crucible of cast iron in the bottom of which is placed powdered graphite. Above this crucible and regulated by a wheel and worm-screw is a large carbon rod, which is connected to the positive pole, the crucible being connected to the negative pole, so that when the arc is set up, the greater heat will be produced in the crucible. The heating chamber, chiefly consisting of the crucible, is, with the exception of the top, surrounded by the water to be heated, and when the arc is struck, the resistance of the graphite is sufficient to prevent short circuits. The arc is also used in soldering irons which are made under the Byng patents in this country. The arc is allowed to play between the carbon rod and copper bit, and heats up the latter to a temperature sufficient for use on large work, The enamel system of heating is certainly the most prominent.

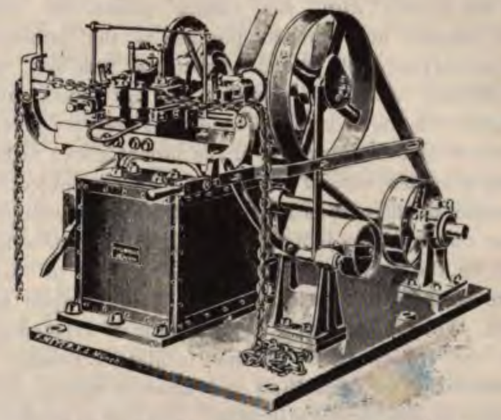


FIG. 2. ELECTRIC WELDING MACHINE.

Another type of electric heater which is well worth mentioning, and that is the electric welder (fig. 2).

The heating effect being proportional to the square of the current, by transforming a high pressure current of small amperage down to one of low pressure and high amperage, it can be used to soften or melt any metal required. From 10,000 to 40,000 amperes per square inch are generally allowed for welding purposes. This welder is an automatic one for welding the links of chains. The chain is fed in at one side with open links and leaves, the other side with the ends of each link welded. Automatic welders are made by this firm for welding bars, rings, spokes to wheels, and ornamental work on to their frames.

A welding transformer weighing 1,000 lb. is used for softening Harveyised armour plates upon which some work is required to be performed after they have been hardened and placed in position. The current is gradually raised to about 10,000, and with a surface of ½ square inch, then gradually decreased so that the portion heated shall be soft when the current is entirely switched off.

A method used for raising bars of metal to a welding temperature is to dip them into a lead-lined tank containing an aqueous solution such as potassium carbonate or borax, and the heat caused by the high resistance film of hydrogen which is evolved at the positive pole to which the rod of iron is connected, soon raises it to a temperature sufficient to melt the metal and cause it to run off from the end of the bar.

TRAMWAY OVERHEAD EQUIPMENT.

At the meeting of the Tramways and Light Railways Association, held in the lecture room of the Society of Arts on Friday last, a paper was contributed by Mr. H. M. Sayers on this subject. With regard to the trolley wire, the author points out that its support and proper position is the principal object of the whole work. As to the best size, the conditions are too complex to lay down any general rule, but where the conditions are very severe it is better to employ one of the bronze alloys rather than a copper wire of larger size. On the subject of position of the wire in relation to track, but assuming that centre wiring is adopted, span-wire construction will be the prevailing type. The flexibility of span-wire construction greatly reduces the blow upon the ears. The soldered ear is the best form of attachment for the trolley wire. Section insulators present a combination of difficulties, and junction special-work fillings require careful attention. The cost of overhead work varies more than it should, but the author is of opinion that thoroughly good span-wire work for either double or single lines can be erected for £1,200 per route mile at a fair profit to the contractor.

RIVER HOOGHLY NAVIGATION.

At the ordinary meeting of the Institution of Civil Engineers on Tuesday, the 17th January, 1905, Sir Guilford L. Molesworth, K.C.I.E., President, in the chair, the paper read was "The River Hooghly," by Mr. L. F. Vernon-Harcourt, M.A., M.Inst.C.E. The following is an abstract of this paper:—

The River Hooghly, which provides the navigable approach to Calcutta, the capital of India, is the most western outlet of the Ganges delta. It possesses the special interest of occupying an intermediate position between tideless and tidal rivers; for, whilst forming one of the many branches of the Ganges delta, like the branches of the tideless, deltaic Mississippi, Danube, and Nile, it flows through an expanding estuary into the sea, like the tidal Seine, Elbe, and Rhine.

On entering the estuary, there soon ceases to be any regularly defined navigable channel; and the course selected for the buoyed channel, through a series of long, deep, pools separated by wide shoals, or bars, over which the depth is under three fathoms at the lowest low water, is merely the line which best combines the greatest available depth with stability and shelter. Various proposals have been made at different times for the improvement of the river, comprising practically all the various methods available for the purpose, namely, diversion of tributaries, diversion of the river across bends, regulation of the river by training works and training-walls, dredging, and dredging and regulation works; but hitherto, beyond a few experimental spurs constructed in the Moyapur reach about 1866, no improvement works have been carried out.

There do not appear to be any peculiar conditions in the case of the Hooghly rendering it incapable of improvement at the worst shoals above its estuary, as has been often asserted; and it is hoped that a careful study of the physical conditions of the river, rendered possible by the excellent charts published during the last twenty years, may lead to a satisfactory solution of the problem as to the best means of improving the river for navigation.

THE SMOKE PROBLEM.

At the monthly meeting of the Institution of Engineers and Shipbuilders in Scotland, there was an interesting discussion on Mr. E. J. Rowan's recent paper on this subject.

Mr. Andrews pointed out that the various authorities quoted by Mr. Rowan in connection with the principles of combustion did not, he thought, agree very well, except on the point that there should be a good supply of air. He did not know if any of the authorities quoted were agreed as to where the air should be admitted, and that was the very point that they knew least about in the actual stoking of furnaces. The stoker had no means of knowing how much air was admitted or how it was admitted, and with a door in front of him he just pitched in coal as the fire required it. How could they expect to get much else but black smoke under such conditions. The stoker ought to be able to take an interest in what was happening during the process of combustion, and there should be some means to enable him to see what was going on.

Mr. Gillespie thought they should concern themselves less with the smoke problem and turn their attention more in the direction of the utilisation of smoke. Smoke, of course, was gas, and that gas had been used in connection with blast-furnaces, etc. He thought it would be quite possible and economical in the case of a work where there were five or six steam boilers to put down a plant for the recovery of the tar and ammonia. The full value of the coal might be got from the recovery obtained under such a system.

STIRLING WATER-TUBE BOILER.

At the meeting of the Staffordshire Iron and Steel Institute on the 21st inst., Mr. Cyril E. Tarbolton read a paper on "The Stirling Water-Tube Boiler," with notes on the purification of feed water by the thermal system. The following is an abstract of the paper.

The author pointed out that the chief points to be aimed at in the design of generating plant are economy of working, economy in maintenance, economy in first cost, and safety. In Mr. Bryan Dawkin's work "The Heat Efficiency of Steam Boilers," it appears that while 107 tests of Lancashire boilers give an average efficiency of 62·4 per cent., the Stirling boiler shows an efficiency of 76·6 per cent., and an average of the ten tests on Stirling boilers given in table on page 204 shows 75·8 per cent. efficiency. In this connection the extremely high efficiency of the boiler fixed at the Sheffield Corporation Lighting Station should be mentioned. Roughly speaking, it may be said that with a water tube boiler, the same efficiency will be obtained as with a Lancashire boiler and economiser, while much larger units can be employed, reducing the first cost very considerably. There is also a saving in floor space with the Stirling boiler.

An ingenious mechanism for cleaning water-tube boilers is described in detail by the author. It consists of a small turbine, the rotating parts of which carry arms and cutters. The whole turbine is dropped into the tube from the upper end, and is connected by 1½ in. hose pipe with the feed pump or other water system at from 100 to 140 lb. pressure. The water having been turned on, the turbine is caused to rotate at a high rate of speed, and the tapping motion of the arms rapidly removes the scale from the tubes; while the exhaust water washes this down in advance into the lower drum.

The Stirling boiler, which is of the vertical tube type, consists essentially of three steam drums, and two mud drums, connected by four main banks or tubes. The tubes, 3¼ in. diameter, are of weldless steel, and are simply expanded into the drums. They are all bent to the same radius, being curved at each end so that they enter the drums radially.

The front and central steam drums are connected both above and below the water level, while the central and back steam drums are connected above the water level only. The two mud drums are connected together.

The three steam drums are carried by a steel framing and from them the water drums are suspended. These are kept quite clear of the side walls and foundations, so that they are free to rise and fall with the expansion of the tubes. In practice these drums drop about ⅜ in. from their position when cold. Another point to be observed is that owing to the spring in the curved tubes, any tendency there may be to unequal expansion in the same bank of tubes, does not lead to leaky joints.

DETAILS OF CONSTRUCTION.

The feed water enters the boiler at the back steam drum, at a part most remote from the fire, and since there is no under-water connection with the central steam drum, its passage must necessarily be down the last bank of tubes, where it is gradually heated up, causing most of the scale to be deposited, the sediment falling into the rear water drum. The water in the front section over the fierce heat of the fire is thus left clean, and the life of the tubes greatly prolonged thereby. This arrangement of the feed enables water to be used which, under ordinary circumstances, would be quite unsuitable for tubulous boilers.

Owing to this construction the circulation is practically perfect, as the tubes are nearly vertical and each has a free outlet into the steam drums. In the horizontally inclined type of water-tube boiler, the tubes are certainly straight so far as cleaning is concerned, but considered from the point of view of circulation, the Stirling boiler has a distinct advantage, since there are no right-angle turns, due to headers, etc., that have to be negotiated.

The nearly vertical position of the tube gives an exceedingly large combustion chamber, and it may also be noted that the tubes are staggered to split up the hot gases, while all the surfaces subject to pressure are cylindrical.

The boiler is also remarkably free from any tendency to prime. A test was made by Professor Ewing on the Stirling boilers supplied to the Brompton and Kensington Electric Supply Company, in order to show the maximum evaporation that could be obtained with forced draught. This worked out at 7·4 lb. water per square foot of h.s. per hour, or nearly double the normal capacity, and the amount of moisture in the steam was only ·063 per cent.

As an example of the ease with which tubes may be scaled by the turbine cleaner, the author was recently informed by the engineer of a large steel works in Sheffield that at the end of a six months' run, three men with a turbine are able to thoroughly clean a Stirling boiler of a size equal to two 30 by 8 Lancashire boilers in one day.

Stirling boilers are also made with three steam drums and one mud drum for marine work, and for use where space is restricted; and again with two steam drums and one mud drum for small powers. About 2½ million h.p. of Stirling boilers are now in use throughout the world.

RESULTS FROM BOILERS WORKING WITH WASTE FURNACE HEAT.

	1. Cornish Boiler and Tube-welding Furnace.	2. Stirling Boiler and Puddling Furnace.	3. Stirling Boiler and Puddling Furnace.	4. Stirling Boiler and Reheating Furnace.
Duration of Test in hours	Mean of 3 1 hr. trials	24	24	12·42
Heating Surface of Boiler in sq. ft	510	1,710	1,710	1,440
Grate area of Furnace in sq. ft. ...	14	10·5	10·5	–
Ratio: Heating surface to Grate area	36·5 to 1	162·8 to 1	162·8 to 1	–
Total Coal used in lbs.	660	12,401	11,760	7,740
Coal used per hour in lbs. ...	660	520	491	621
Total Water evaporated in lbs. ...	1,710	93,310	94,170	46,640
Water evaporated per hour in lbs.	1,710	3,890	3,920	3,240
Water per sq ft. of H.S. per hour	3·36	2·27	2·29	2·62
Average water per hour per lb. of Coal	2·6	7·52	8·0	6·05
Temperature of Feed in Fahrenheit	50°	139°	153°	56°
Temperature of Flue Gases in Fahrenheit	–	379°	390°	408°

No. 1 represents the results from a Cornish Boiler fired with waste heat from a Tube-welding Furnace at Great Bridge. Fuel: Large Coal.

Nos. 2 and 3—Tests from a pair of Stirling Boilers working from Puddling Furnaces near Leeds. Fuel: Yorkshire Slack and Steam Jet draught.

No. 4—Test from a Stirling Boiler and Steel Re-heating Furnace. Fuel: Slack and Steam Jet draught.

In the thermal method of treatment described by the author, the feed water is subjected to practically the same conditions as will obtain in the boiler itself. The temperature is raised by live steam to nearly that of the water in the boiler, with the result that the carbonates and greater part of the insoluble sulphates are precipitated (where these exceed 16 gr. per gallon) just as they would be in a boiler.

By permission of Mr. J. Clifton Robinson, M.I.M.E., a visit of the Members of the Tramways and Light Railways Association to the Works of the London United Tramways has been arranged to take place early in February. The Association has already visited the power stations of the principal electric railways in London.

A SHAFT SIGNALLING DEVICE.

BY E. H. GARTHWAITE.

A paper on this subject was read before the last meeting of the Institute of Mining and Metallurgy.

The writer would like to mention a mechanical device which he came across many years ago in Mexico, and which he has since used with great satisfaction, especially in shafts 500 to 1,000 ft. deep.

The accompanying diagram shows the arrangement of this device, and it will be seen that the bell-rope from the shaft, whether vertical or inclined, winds round a drum made of wood with the sides bolted on; galvanised iron wire rope, ¼ in. in diameter, is generally used. An L shaped lever is bolted to one side of the drum, to one end of which is attached a rope communicating with the engine-room.

A special feature of the apparatus is the counter-weight, which consists of an iron cylinder (generally a small oil drum), which can be filled with scraps of iron, etc., so that it just counter-balances the weight of the bell-rope. This makes it possible to pull the bell-rope with but very slight exertion, so that if one is riding in a cage or bucket, at a medium speed, it is possible to give a signal to stop if necessary. The counter-weight rests on a bracket and usually a guard is placed around it so as to prevent the possibility of its tipping over.

With this device, moreover, a gong can be satisfactorily used, for overstraining is prevented by the lug A on the signal drum.

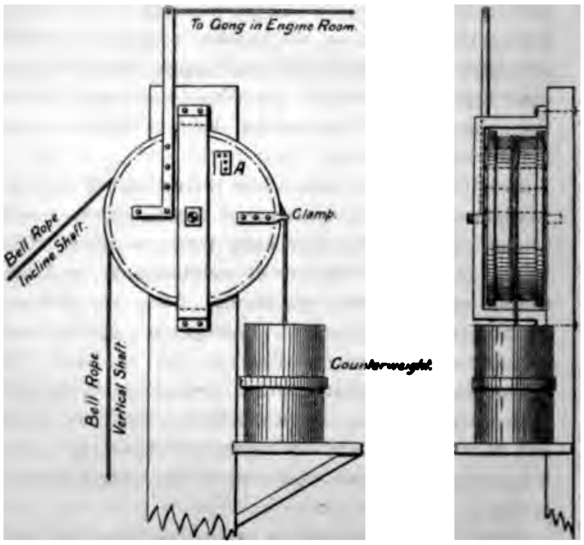


FIG. I. ARRANGEMENT OF SHAFT SIGNAL FOR 1,000 FT. OF ¼-IN. ROPE.

STREET LIGHTING BY ELECTRICAL ARC LAMPS.

At the meeting of the Glasgow Local Section of the Institution of Electrical Engineers, held at Glasgow on the 10th inst., Mr. H. B. Maxwell read a paper on this subject, of which the following is an abstract :—

The chief reason that arc lighting has not been more extensively used for street lighting is that station engineers do not charge low enough rates to make it commercially practicable, probably because they do not realise that street lighting has a load factor of over 42 per cent.

If arc lighting is adopted the following points should be considered : size and type of lamp to be used ; height of lamp from ground ; distance between lamps ; position of lamps ; whether trimming shall be with lowering gear or ladders ; whether circuits should be connected to distributors or not ; switching gear, etc., in the poles, and charge to be made per lamp per annum.

The first point to be considered is, whether open or enclosed arc should be used. The open type is much superior for street lighting, as it is much cheaper to maintain, and the colour of the light is very much better. Only five enclosed lamps can be run in series on 480 volts, as against ten open, if allowance is made for the resistance of cables, etc., and a 6-ampere enclosed lamp does not give as much light as a 10-ampere open. Enclosed lamps also do not run well in series. The author is of opinion that the 10-ampere open type arc lamp, pendant from a swan neck or bracket, in all streets will be found most satisfactory. Globes should undoubtedly be plain opalescent of such a density that the carbons are quite visible during the daytime.

The height of a 10-ampere arc from the ground level should be 20 ft., and, except in streets with very fast and heavy traffic the distance apart is not of such importance as that lamps should invariably be placed at street corners so as to get the maximum efficiency from the lamps. In main streets, where there are tramways, the lamps may be placed from 60 to 80 yards apart to suit the corners ; in less frequented streets this may be increased to 90 yards ; and in side streets to 100 yards, or even more in special cases.

The author is of opinion that it is most necessary to control the street arc circuits direct from the station by separate feeders. It is essential to have in the base of every pole at least an isolating switch and a substitutional resistance. The latter are very necessary, as without them the circuits are liable to be seriously overrun in the event of lamps failing, owing to shortness of carbon or other causes. An automatic cut-in must, of course, be provided either in the lamp itself or in the base of the pole, in order to substitute the resistance when the lamp fails. The author prefers the latter position, as the cut-in is then more accessible and a third wire up the pole is unnecessary.

CAPITAL COST FIGURES.

The capital cost of installing 400 10-ampere arc lamps, with poles, resistances, cables, roadwork, switchgear, etc., will be about £24,000, so that the annual cost per annum, including all charges, will be—

	Total.	Per lamp.
7 per cent. interest, sinking fund and depreciation, on £24,000	£1.680 0 0	£4 4 0
Carbons—75,000 pairs at £4 10s.	337 5 0	0 16 10
Wages—five trimmers, repair hand, and mate	455 0 0	1 2 9
Repairs, painting, etc	100 0 0	0 5 0
672,000 units at 1d. per unit ..	2,800 0 0	7 0 0
	£5,372 5 0	£13 8 7
	Say ..	13 10 0

It may be noted that charges on capital and for current will form over 80 per cent, of the total cost of the lamp if 1d. per unit is charged for current. It is therefore to these two items the author looks for any large reduction in price, although it is essential that the other items should be kept down if cheap arc lighting is required.

Seven per cent. should be allowed for interest, sinking fund, and depreciation.

The only items that should be included in the charge for current for street lighting are the works costs, exclusive of wages (which should not be increased at all by the addition of a street lighting load), and interest, sinking fund, and depreciation on the capital cost for boiler, generator, and condenser plant. The cost of all cables, feeders, and switchboards has already been debited against the capital cost of the street lighting, so that £40 per kilowatt demanded, even after providing for a small amount of spare plant, will be more than sufficient to cover the increased cost of station plant due to the street lighting. Eight per cent. interest, etc., on this sum will be a charge of £3 4s. per kilowatt per annum, which, at 3,500 units per kilowatt per annum, works out at 0·22d. per unit. Any other items, such as insurance or office costs that may be increased by the addition of street lighting, will be amply provided for by 0·03d., so that a station can supply for street lighting at the following rate: works costs— wages + 0·25d.

If considered necessary a small addition to this price may be added for profit (every 0·1d. adding £280 to the revenue from four hundred lamps), but in the author's opinion no such increase is necessary, as the decreased cost per unit of coal, stores, and repairs (especially the last item), owing to the much better load factor, will in itself cause a considerable profit. Thus, if the increased load factor reduces these costs by only a farthing, a profit of £700 will accrue from the 672,000 street-lighting units, in addition to that realised from the whole units generated from the station.

THE PARTICK SYSTEM OF STREET LIGHTING.

A description of the arrangements made in Partick is given by the author: The lamps adopted are all of the 12½-ampere open type, run ten in series on the outers of the three-wire system at 480 volts, and number in all 290, which number is shortly to be increased to 300.

The distance at which the lamps at present in use can be placed, while at the same time maintaining a good light, is surprising. In several streets the lamps are placed as far apart as 180 yards, and the result is excellent.

If in any circuit the lamps are particularly far apart, the circuit is overrun at 13 amperes, which gives a considerable increase in candle-power, or, if in others they are close together, the circuit is run at 12 amperes. This method of regulating the circuits is not generally made use of, but it is very effective, and it has been found that the extra current in no way hurts the lamps, that no special adjustment is necessary for only ½-ampere variation from the normal, and that even at 13 amperes the carbons last for more than two days even in the middle of winter.

The arc circuits are entirely run with 7-16 twin lead-covered wires laid solid, the two conductors being insulated with different coloured papers, so that they may be distinguished. The cables are looped in and out of each pole, cut and all the ends sealed in one sealing chamber. Two wires of one colour are connected into the isolating switch, the two of the other colour being joined together by a detachable connector. By this means every length of cable between poles can be tested separately.

Contiguous lamps are connected alternately on the red and white conductors, and where the ends of two circuits of ten lamps are close to each other the two circuits are connected in series, thus forming two separate single-wire circuits, with contiguous lamps on different circuits. The circuits have, as far as possible, been run in this manner, so that when a fuse blows only every alternate lamp is out till it has been replaced.

The circuits are supplied from feeder pillars, which each control from four to six circuits, in which the fuses and line resistances are placed, these being supplied from the station by independent feeders and from separate bus bars. The street lighting is started on separate machines from the ordinary supply, and afterwards paralleled on to the main bars, thus obviating any irregularity in the ordinary lighting due to switching on several circuits at once. As the machines are separated out again a dawn and shut down on the load, the feeder switches are only separated in the case of emergency, which is a great saving to the switches, as the arc formed when opening arc circuits at 500 volts is excessive owing to induction. Also if at any time an arc circuit or feeder is earthed so that a fuse will not hold, all that is necessary is to open the paralleling switch and run with one pole earthed till the fault is remedied. If the earth is on a circuit it can then be easily isolated by testing at each lamp to earth with a volt meter. This arrangement is very useful, as a negative carbon dropped through is sufficient to cause earthing on arc circuits.

To emphasise the importance of electric street lighting, it may be stated that, even in a comparatively small town like Partick, the revenue from current alone from the three hundred street lamps amounts to nearly £3,000 per annum, and in the carrying out of the scheme some £18,000 has been spent with manufacturers in this country.

The Junior Institution of Engineers recently visited the works of the Voelker Incandescent Mantle Company

The works were kept specially running for the benefit of the visitors, and all the processes of manufacture were seen, under the guidance of the general manager, Mr. Clark, and the works manager, Mr. Young. They consisted of the winding of the ramie thread off the spools as received at the works, on to reels. for the weaving machines; the weaving of the thread into fabric of continuous tube formation; treatment by means of chemicals to thoroughly cleanse the fabric; cutting into lengths according to the size of mantel required; sewing on of the strengthening end piece; impregnating with thorium through small roller machines; drying; seasoning; collodionizings; trimming; and boxing. The works give employment to about 400 hands, and the total output is 30,000 mantles per day.

BRITISH TRADE PROSPECTS IN CHINA.

THE address on British commercial prospects in China, which Mr. Byron Brenan, late Consul-General at Shanghai, delivered before the Society of Arts on Tuesday afternoon, bristles with information which ought to be noted in engineering circles. Too much, he pointed out, is made of the supposed advantages to British trade arising from the opening of new Treaty ports. These new ports do not attract foreign traders, for the simple reason that the Chinese trader can undersell his European rival. The tendency in China is therefore for foreign traders to concentrate at a few centres, and this tendency will probably remain, however much China may be opened up, or the means of transportation improved. It is the volume of trade rather than its local features which concerns the British manufacturer, and in this respect there is room for immense development in China.

A POLICY FOR RAILWAY CONTRACTORS.

It is, of course, the construction of railways and the opening of mines which present the best opportunities for the employment of British capital in China. In the matter of railway construction Mr. Brenan suggests that the man who proposes the cheap and gradual method of construction has the best chance of obtaining concessions for engineering work in China. It is better to begin with a single line, light rails, wooden bridges and temporary stations, and leave the heavy expenditure to come out of the earnings of the line itself. Moreover, it is policy for a contractor to buy Chinese materials wherever he can, and it may be noted that the Belgians are buying large quantities of material from the Government iron works at Han-Yang for the line they are now constructing. On the subject of future British railways in China a good deal depends on the results achieved by the line now building from Shanghai to Nanking, and passing through the richest portion of the Empire.

THE DEMAND FOR MACHINERY.

There was a time in China when Britain dominated the commercial situation ; now it is far otherwise, our rivals are not only very numerous, but most unpleasantly alert. Hankow shows a notable example of this. The new trade is chiefly in the hands of French and German firms, and the Germans and the Belgians have secured for themselves all the Chinese contracts for machinery of every description, the local arsenals, ironworks, and mint being fitted with their manufactures. And the demand for mechanical appliances will grow, so that unless British firms are prepared to lose the trade they must educate China into a belief in British engineering work. An industry in China, capable of great developments and which is peculiarly British in character is coal mining. It is said that the coal fields of China would supply the world with coal for 3,000 years, and yet China is importing coal at a cost of a million sterling per annum. Here, then, is a field which appears to offer unlimited opportunities to the mining man and the manufacturer of coal mining machinery.

There is much else in Mr. Brenan's paper which is interesting and instructive. He shows that there are engineers even in unregenerated China ; the Chinese indeed are famous bridge builders, and the roads on the banks of rivers often give evidence of engineering skill. Mr. Brenan reveals, too, the absurdities of China's fiscal system, and the need for a change of tactics by the representatives of British industries. He believes that the present war will have a good effect on British trade with China. Sir Edward Sassoon, who presided at the lecture, dealt with the political side, but into the diagnosis of diplomatic palsy, and the question of whether British occupation of the Yangtse Valley is as effective as it should be, it is not the province of PAGE'S WEEKLY to follow him.

LAUNCHES AND TRIAL TRIPS.

TRIALS OF NEW DREDGER.

The new combined bucket and pump hopper dredger *Murihiku*, built by Messrs. Wm. Simons and Co., Ltd., of Renfrew, to the order of the Agent-General for New Zealand, has completed all her contract dredging and steaming trials with satisfactory results. At the bucket dredging trials the hopper was completely filled in twenty-five per cent. less time than stipulated by the contract, and the pumping trials were equally satisfactory. The speed trials gave a result of over 7½ knots per hour.

SELBY.

Messrs. Cochrane and Sons, shipbuilders, Selby, aunched on the 24th inst. a steel screw trawler, *Calabria*, the principal dimensions being 122 ft. by 21 ft. 9 in. by 11 ft. 3 in. depth of hold. The vessel has been built to the order of Messrs. The Grimsby Alliance Steam Fishing Company, Ltd., of Grimsby, and is being fitted with powerful triple expansion engines by Messrs. Charles D. Holmes and Co., of Hull.

LAUNCH OF A CLAN LINER.

Messrs. W. Doxford and Sons, Ltd., have just launched the large turret deck steamer *Clan Maclean* from their yard at Pallion. The vessel is built to the order of the Clan Line Steamers, Ltd. (Messrs. Cayzer, Irvine and Co.), Glasgow, and is a duplicate of several vessels already launched, and of others in hand, for the same firm. The length is 405 ft., breadth 50 ft., moulded depth 29 ft. Deadweight capacity 7,000 tons. Messrs. Doxford have supplied the engines, with cylinders 27½, 45½, and 75; stroke 54, and also the three boilers, 14 ft. 8 in. diameter, and 11 ft. 9 in. in length.

THE TYNE.

On Monday afternoon there was launched from the yard of the Northumberland Shipbuilding Company, Ltd., Howden-on-Tyne, the fine steel screw steamer, built to the order of Messrs. The Navigazione A Vapore "Napried," Ragusa, Dalmatia. The steamer is 351 ft. long by 46 ft. 10 in. beam by 27 ft. 4 in. deep., and has been constructed to a fine model with a view to rapid speed and economy in fuel. The machinery which will be supplied by the North-Eastern Marine Engineering Company, Ltd., will consist of engines with cylinders 24 in., 40 in., and 65 in., by 45 in. stroke, two large steel boilers 15 ft. 9 in. by 10 ft. 6 in., 160 lb. working pressure.

THE WEAR.

Messrs. S. P. Austin and Son, Ltd., Sunderland, launched on the 23rd inst. the steel screw steamer *Herrington*, which has been built to the order of Sir James Joicey, Bart., M.P., for the Lambton Colleries, Ltd. The vessel is designed to carry about 1,900 tons deadweight on a light draft; she has large hatchways for easy trimming, ample water ballast in cellular double bottom, and fore and after peaks for making good light passages, and other features specially adapting her for the owners' coal trade. Triple expansion machinery will be supplied by Richardsons, Westgarth and Co., Ltd.

Messrs. Wm. Pickersgill and Sons, Southwick, Sunderland, launched on the 21st inst., a finely modelled screw steamer, built to the order of Messrs. Hamilton Fraser and Co., Liverpool, this being the second ship built for them by the above firm. The vessel has a deadweight capacity of about 6,650 tons, and an exceedingly large cubic capacity. She was named *Inchborva*, and is to be engined by Messrs. Geo. Clark, Ltd., Southwick, Sunderland.

NEW PASSENGER BOAT.

The large passenger steamer *La Madona* was launched on Monday last by Swan, Hunter, and Wigham Richardson, Ltd., which is being built for the Richmond Steamship Company, Ltd. The steamer is built of steel and fitted with twin screws. She is 430 ft. in length between perpendiculars, by 48 ft. beam, and is being built to take the highest class in the Bureau Veritas Register. The accommodation for first-class passengers and a large number of emigrants is very complete, and nothing has been omitted which will tend to their comfort. The steamer is to be propelled by twin screw triple expansion engines, which are also being constructed by the builders, and are expected to give the vessel a speed of 16 knots.

HULL.

There was launched from the yard of Earle's Shipbuilding and Engineering Company, Ltd., Hull, on the 12th inst., the *Laura* steam trawler, built to the order of Messrs. Moodys and Kelly, Grimsby, for the Fleetwood Steam Fishing Company, Ltd. Her dimensions are 126 ft. 8 in. by 22 ft. by 12 ft. 10½ in. moulded, and she will be fitted with triple expansion engines having cylinders 12½ in., 22 in., and 36 in. diameter, by 24 in. stroke, supplied with steam from a large steel boiler working at 180 lb. per square inch.

CONTRACTORS' NEWS.

We shall be pleased to insert, under this column, free of charge, particulars of open contracts.

CONTRACTS OPEN.

	Last Day.
Harrogate. — Supply and delivery of welded steel pipes and other materials in connection with the Masham Scheme Works; to be delivered at Ripley Station of the North-Eastern Railway. Mr. Edward Wilson Dixon, Engineer, Albert Street, Harrogate	Jan. 28
Bradford.—Supply of steel girder, tramway rails, fishplates, steel poles. etc. Mr. Frederick Stevens, Town Clerk	Jan. 28
Chertsey. — Construction of two bridges across River Wey. Mr. R. St. George-Moore, 17, Victoria Street, S.W.	Jan. 30
Ebbw Vale.—Construction of Carno reservoir (three contracts). Engineer, Mr. Geo. F. Deacon, 16, Great George Street, Westminster, S.W.	Jan. 31
Halifax.—Supply and erection of a coal conveyor, shutes, etc., for the Tramways and Electricity Committee. Mr. W. M. Rogerson, Borough Electrical Engineer, Foundry Street, Halifax	Jan. 31
Manuden.—Erection of an iron girder bridge at Common Mead, Manuden, Essex, for the Stanstead Rural District Council. Mr. Chas. Hicks, Surveyor, Stanstead, Essex	Feb. 1
London.—Supply of bearing plates for the Egyptian Delta Light Railways, Ltd., Mr. E. L. Marryat, Managing Director, 211-214, Gresham House, Old Broad Street, London, E.C.	Feb. 1
Salford.—Supply and erection of steelwork, wrought and cast-ironwork, brickwork, masonry, etc., required in the reconstruction of two bridges for the Building and Bridges Committee. Engineers, Messrs. C. S. Alliott and Son, 46, Brown Street, Manchester	Feb. 2
Handsworth. — Supply and delivery of power and lighting circuits and fittings for generating station (Contract 10), Pipework, Feed-pumps, Economiser (Contract 11), electricity meters (Contract 12). Mr. H. Ward, Clerk, Handsworth, Birmingham.	Feb. 2
Kirkcaldy.—An extension of about 500 ft. to present East Pier for the Town Council. Mr. Wm. L. Macendoc, Town Clerk	Feb. 4
Woking.—Supply and erection of steel gasholder and steel tank for the Woking District Gas Company. Mr. B. Dennett Holroyd, Secretary, 5 and 6, Great Winchester Street, E.C.	Feb. 11
Nottingham.—Construction of reservoir at Wilton Hill. Mr. F. W. Davies, Water Engineer, Water Offices, St. Peter's Square	Feb. 13
Todmorden.—Supply and fixing complete at their Millwood works two new purifiers, 25 ft. square, on Green's principle, with centre valves complete, for the Gas Committee. Mr. H. Hawkins, Engineer, Gasworks, Millwood, Todmorden...	Feb. 13
Stockport.—Overhead equipment of about four miles of electric tramway, and also supply of copper rail bonds, for the Tramways Committee. Mr. A. J. H. Carter, Borough Electrical Engineer, Millgate, Stockport	Feb. 16
Cape Clear.—Construction of breakwater, etc., according to plans to be seen at Coastguard Station, Baltimore. Office of Public Works, Dublin	Feb. 17
Bury (Lancs.)—Cutting and refilling track and laying and jointing 10,500 lineal yards of 12 in. diameter cast-iron pipes from Gin Hall reservoir, near Bury, to Whitfield, and other relative works, for the Bury and District Joint Water Board. Mr. J. Cartwright, Civil Engineer, Peel Chambers, Bury	Feb. 18
South Shields. — Execution of works and supply of plant in connection with the construction of overhead electric tramways. Mr. J. Moore Hayton, Town Clerk.	Feb. 20
Brisbane.—Supply of steel rails and steel fishplates. Agent-General for Queensland 1, Victoria Street, S.W.	Mar. 7
Lulea (Sweden).—Widening and deepening of the Channel, "Tjufholssundet," at Lulea. Harbour Commissioners, Lulea, will supply particulars	April 1
Bermuda,—The Crown Agents for the Colonies are prepared, on behalf of the Government of Bermuda, to receive tenders for the deepening, widening and buoying of the channel leading from sea into St. George's Harbour, in the Islands of Bermuda. Particulars of Messrs. Coode, Son and Matthews. 9, Victoria Street, S,W. Tenders to Crown Agents for Colonies, Whitehall Gardens, S.W. ...	—
Manchester.—Supply of new or sound second-hand portable 18-in. gauge railway, with metal sleepers, fish-plates, bolts, turn-out switches, etc.; also wagons of half to three-quarter yard capacity, for the Manchester Corporation. Appy to Mr. T. de Courcy Meade, City Surveyor, Town Hall, Manchester.	—

COMING CONTRACTS.

New Zealand. — The Wellington and Auckland electric tramways are to be extended. At Wellington the amount to be expended is about £77,000. It has not yet been decided whether the work will be carried out by contract.

Newcastle-on-Tyne.—The Tramways Committee have decided to instruct the city engineer to prepare plans for the extension of the tramways.

Yarmouth.—Application is to be made by the Corporation for a loan of £10,000 for new plant, including another 300-kilowatt engine and dynamo and boilers, at £4,500, and an additional water conduit, estimated to cost £3,500. The Corporation is about to expend £56,000 on electric tramways.

Anstruther.—Amended plans by Mr. Henderson, Edinburgh of the proposed harbour extension at Anstruther, were submitted at the monthly meeting of the Harbour Board. The estimated cost of the extension has been increased to £36,704.

Windermere.—It has been decided to place orders for a number of additional motor-cars on the Windermere-Keswick route.

Norwich.—Application is to be made for loans of £30,000 for the purposes of the electricity undertaking to September 30, 1907.

Kirkcaldy.—It is stated that the Town Council have received sanction to borrow £30,000 for works connected with the electric supply undertaking.

Brooklyn Bridge (N.Y.).—The engineers have recommended the adoption of plans entailing the virtual reconstruction of the bridge, and the cost is roughly estimated at £1,000,000.

Knaresborough. — The Harrogate Corporation engineer, Mr. E. W. Dixon, has been retained to examine the plans of the District Council for a drainage scheme for Pannal, estimated to cost £20,000.

CONTRACTS CLOSED.

Fife.—Graham, Morton and Co., Ltd., have just installed a new conveying plant at Michael Colliery, Fife, for the Wemyss Coal Company.

Japan.—Robert Stephenson and Co., Ltd., Darlington, have received an order for eighteen locomotives for the Imperial Railways of Japan.

Leeds.—The Corporation have placed an order for 850 tons of steel tramway rails with Walter Scott, Ltd.

Edinburgh.—An order has been placed with the Whessoe Foundry Company, Ltd., Darlington, for gas purifiers.

United States Government. — William Johnson and Sons (Leeds), Ltd., have received an order from the U.S.A. Government for one of their coal briquette plants as the result of their exhibit at the recent World's Fair.

Chippenham.—The tender of Mr. E. Ireland, of Morecambe, has been accepted for sewage and sewage disposal works at the sum of £11,550.

Belfast.—Messrs. Harland and Wolff, of Belfast, have obtained an order from the owners of the Bibby Line for a new 8,000 tons steamer, a sister ship to the *Worcestershire*. The new vessel is to be named the *Herefordshire*.

Cradley Heath.—Messrs. Richard Sykes and Son, Ltd., of Cradley Heath, have obtained a large foreign order for the supply of cable and other chains.

London.—The Brush Electrical Engineering Co., Ltd., have secured the following contracts: Four cars complete with B.T.H. motors for Colne and Trawden Light Railways, through Greenwood and Batley; four 60-k.w. transformers, four 25-k.w. transformers, through Midland Electric Corporation, for Power Distribution, Ltd.; thirty-four carbodies; one car complete with Radial Action Truck, and Raworth's Regenerative Control Equipment for the West Ham Corporation.

Burma.—Lobnitz and Co., Ltd., Renfrew, have received an order for gold-dredging machinery for Burma, which is to be built under the direction of Messrs. Burt and Kirkcaldy.

Whitby.—The Urban District Council have accepted the tender of Messrs. C. A. Parsons and Co. for a 200-k.w. steam turbine.

Rotherham.—Messrs. S. Dixon and Son, Ltd, of Leeds, have received an order from the Rotherham Corporation Tramways Department for the installation of Turner's automatic point controller.

APPOINTMENTS VACANT.

Last Day.

Ashton-under-Lyne. — Temporary employment as electrical engineer. Mr. G. H. Partington, Poor Law Office, Ashton-under-Lyne ... ... Jan. 31

East Indian Railway.—Assistant locomotive superintendent. Salary Rs. 350 rising to Rs. 400 per calendar month. Mr. C. W. Young, Secretary, 28, Nicholas Lane, E.C. ... ... Feb. 11

India Office.—Assistant engineers in the permanent establishment of the Indian Public Works' Department. Secretary, Public Department, India Office, Whitehall, S.W. ... ... May 1

APPOINTMENTS FILLED.

Chesterfield.—The Town Council has decided to appoint Mr. R. L. Acland, electrical engineer, to the joint offices of electrical engineer and manager of the Tramways Department at an initial salary of £350 per annum.

Walthamstow.—Mr. Fooks Bale, of Birkenhead, has been appointed electrical engineer and tramways manager to the Walthamstow Urban District Council at a salary of £400 a year.

Ramsgate.—Mr. M. Farrer has resigned the position of chief assistant to the Twickenham and Teddington Electric Supply Company, Ltd., to take up the position of resident engineer to the Ramsgate and District Electric Supply Company, Ltd.

Singapore.—Mr. Lewis D. Landay, has been appointed general manager of the Singapore Electrical Tramways Company. This company, which has a capital of £650,000, will commence its operations in April next.

Chester.—Mr. Percy Heard has been appointed to the position of superintendent at the Chester Corporation electricity works.

Battersea.—Mr. W. A. Kemm, chief assistant electrical engineer, has been recommended for appointment as chief electrical engineer to the Borough of Battersea at an initial salary of £350 per annum.

Engineering Standards Committee. — Mr. James C. Inglis, General Manager of the Great Western Railway, has been nominated by the Council of the Institution of Civil Engineers as one of their representatives on the Engineering Standards Committee, in the place of the late Mr. John Allen McDonald, Engineer-in-Chief of the Midland Railway.

Midland Railway.—The Directors of the Midland Railway have appointed Mr. John Elliot to the position of superintendent of the line, in succession to Mr. T. Eaton. Mr. Elliot was formerly passenger agent at St. Pancras, and on the decentralisation of the superintendent's department in October, 1901, he was appointed London district superintendent. He became outdoor assistant superintendent of the line on January 1st, 1903.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares business is urrently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our ist will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from inaccuracies.

Stock Exchange Settling Days.—Settling days on the Stock Exchange are as follows :—

sols: February 1st. General Settlements : January 27th, February 10th, 24th. Bank Rate, April 21st, 3 per cent.

-ENGINEERING, IRON, AND STEEL COMPANIES.

Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
5	5%	Alldays & Onions Pneumatic Engineering, Ltd.	3	2¾— 3
5	3/-	Do. Cum. Pref. 6 per cent.	5	4½— 5
1	2/6	Armstrong (Sir W. G.), Whitworth and Co., Ltd.	1	3¼— 3⅜
5	2/-	Do. 4% Cum. Pref.	5	5⅜— 5⅝
100	4%	Do. 4% 1st Mort. Dbs. Rd.	100	102 —104
100	4½%	Aveling and Porter, Ltd., 4½% Reg. Mt. Debs. Red.	100	96 — 99
1	1/7½	Babcock and Wilcox, Ltd., Ord.	1	3½— 3⅝
1	7½d.	Do. ,, 6% Cum. Pref.	1	1½— 1⅝
5	3/-	Baker (Joseph) and Sons, Ltd., 6% Cum. Pref.	5	5 — 5½
1	6⅝d.	Baldwins, Ltd., 5½% Cum. Pref.	1	1 — 1⅛
Stk	4½%	Do. 1st Mt. 4½% Deb. Stk. Red.	100	101 —103
4½	2/8⅝	Barrow Hæmatite Steel Co., Ld., O.	4½	1 9/16— 1 11/16
4½	6/-	Do. do. Cum 2nd. Pref.	4½	4¼— 4¾
5	2/6	Bayliss, Jones and Bayliss, Ltd., 5% Cum. Pref. Shares	5	4¾— 5¼
100	—	Beardmore (Wm.) & Co., Ltd., 4½% 1st Mt. Debs., Red., Scrip 50% pd	—	100 —102
10	6/-	Bell Brothers, Ltd., 6% Cum. Pref.	10	11¾— 12¼
Stk	4%	Do 4% Deb. Stock, Red.	100	98 —100
1	6d.	Bengal Iron and Steel Ord.	1	1 — 1⅛
1	1/-	Beyer, Peacock and Co., Ltd., Ord.	1	9/16— ⅝
1	6⅝d.	Do. 5½% Cum Pref.	1	13/16— ⅞*
Stk	4½%	Do. 4½% Red. Deb. Stock	100	94 — 97
1	6d.	Bolckow, Vaughan and Co., Ltd., O. Nos. 1-1,629,760	1	1 — 1 1/16
1	3⅜d.	Do. Nos. 1,639,101-3,500,000	12/-	17/32— 19/32
1	4½d.	Brown (John) and Co., Lim., Ord., Nos. 1-1,160,000	15/-	1¼— 1⅜
1	6d.	Do. Ord., Nos. 1,160,001-1,750,000	1	1 25/32— 1 27/32
10	5/-	Do. 5% Cum. Pref.	10	11 — 11¼
5	2/6	Cammell, Laird & Co., Ltd., Ord.	5	8¾— 9¼
5	2/6	Do. 5% Cum. Pref.	5	5⅛— 5¼
1	1/6	Clayton & Shuttleworth, Ltd., Ord.	1	31/32— 1 1/32
5	2/6	Do. 5% Cum. Pref	5	5¼— 5½
Stk	4%	Do 4% 1st Mort. Db. Stk. Red	100	100 —102
10	30/-	Consett Iron Co., Ltd., Ord	7½	33 — 35
10	10/-	Crossley, Bros., Ld., Ord. 40340/97370	10	16 —16½
10	5%	Do. 5% Cum. Pref.	10	11⅜—11⅝
1	2/6	Delta Metal, Ltd. Shares	1	1⅞— 2⅛
1	3⅜d.	Dorman, Long & Co., Ltd.	1	⅝— ¾
Stk	4%	Do. 4% 1st Mort. Perp. Deb. Stk.	100	90 — 93
Stk	—	Do. 6% 2nd Mort. Deb Stk, Red.	—	94 — 96
5	3/-	Dunderland Iron Ore Co., Ltd., 6% Cum. Pref. and Participating	5	2⅞— 3½
1	9⅜d.	Dunlop (James) & Co., Ltd., Ord.	1	⅝— ¾
1	7½d.	Do. 6% Cum. Pref.	1	⅞— 1
13	12/-	Ebbw Vale Steel, Iron & Coal Co., Ltd.	13	9 — 10
13	12/-	Do. do. do.	10	7⅞— 8⅛
10	8/-	Elliott's Metal, Ltd.	8	4½— 5½
10	5%	Do. Cum. Pref. 5%	10	8¾— 9¼
Stk	4%	Do. Deb. 4%	100	93 — 98
10	6/-	Fairfield Shipbuilding & Engng. Co., Ltd., 6% Cum. Pref.	10	10½— 11*
Stk	4½%	Do. 4½% Mort. Deb. Stk. Red.	100	97 —100*
10	10%	Fleming & Ferguson, Ltd, Ord. Nos. 1/9000	10	12 —12¼
10	5%	Do. 5% Cum Pref. Nos. 9001/15000	10	9⅝— 9⅞
3	3/-	Fraser & Chalmers, Ltd., Ord.	3	4⅝— 4⅞
3	1/6	Do. 7½% Cum. Pref.	3	5½— 6
10	5%	Galloways, Ltd., 5% Cum. Pref. 18001/28000	10	6 — 7
Stk	4%	Do 4% 1st Mort. Deb Red.	100	90½—91½
1	1/-	Guest, Keen & Nettlefolds, Ltd. Ord.	1	2 5/16— 2 7/16
5	2/6	Do. 5% Cum. Pref.	5	5⅞— 6⅛
Stk	4%	Do. 4% Irred. Mort. Deb. Stk	100	105 —107
5	2/6	Gwynnes, Ltd., 5% Cum. Pref.	5	2 — 3
1	1/-	Hadfield's Steel F'dry Co., Ld., Ord.	1	3⅜— 3½
10	4/6	Do. 4½% Cum. Pref.	10	10½ — 11
5	3/-	Hall (J. & E.), Ltd. 6% Cum. Pref.	5	5 — 5½
1	1/6	Harvey United Steel Co., Ltd.	1	1 5/16— 1 7/16
10	7½%	Hawthorn, Leslie & Co., Ltd. Ord.	10	11 —11¼
5	7/-	Head, Wrightson & Co., Ltd.	5	4¾— 5¼
1	7½d.	Hill (Richard) & Co. (1899) Ld., Ord.	1	13/16— 15/16
5	3/-	Do. 6% Cum. Pref.	5	4¾— 5
10	6/-	Hornsby (Richard) & Sons, Ld., Ord.	8	5¾— 6¼

ENGINEERING, IRON, AND STEEL COMPANIES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
750,000	1	6d.	Howard & Bullough, Ltd., Ord.	1	1 11/16—1 13/16
25,000	10	6/-	Do. 6% Pref. (Non-Cum.)	10	12¼— 12¾
£250,000	Stk	4%	Do. 4% Deb. Stk., Red. after 1905	100	98 —101
37,500	10	20	Kynoch, Ltd.	10	19 — 20
49,537	10	5%	Do. Cum. Pref. 5%	10	10½— 11
300,000	1	4⅜d	Lambert Bros., Ltd., Ord.	1	⅝— ⅞
50,000	5	2/9	Do. 5½% Cum. Pref.	5	4 — 4½
40,000	3	2/1½	Leeds Forge Co., 7% Cum. Pref.	3	3¾— 4¼
200,000	1	7½d.	Lysaght (John), Ltd., 6% Cum. Pf.	1	1 5/16— 1 7/16
£300,000	Stk	4½%	Do 4½% 1st Mt. Deb. Stk., Red.	100	108 —110
40,000	10	5/-	Mather & Platt, Ld., 5% Cum. Pref	10	11 — 11½
210,000	1	6d.	Measures Bros., Ltd., Ord.	1	⅝— ¾
75,000	1	6⅝d.	Do. 5½% Cum. Pref.	1	13/16— 15/16
£75,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	96 — 99
21,943	5	2/6	Muntz Metal, Ltd.	5	5 — 5½
14,248	5	5%	Do. Pref. 5%	5	5⅛— 5⅝
5,000	62½	47/6	Nantyglo and Blaina Iron Works, Ltd., 8% Cum. Pref.	62½	74 — 76
73,000	10	5/-	N. Brit. Loco. Co., Ltd., 5% Cm. Pf.	10	11¾— 12
80,000	5	—	North-Eastern Steel Co., Ltd., Ord.	5	—
£250,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	90 — 93
122,000	5	2/-	Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B"	5	3¾— 4
50,000	5	3/-	Do. 6% Cum. Pref. "A"	5	5¾— 6¼
70,000	10	6/-	Pease & Partners, Ltd., Ord.	10	10— 10½
£400,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	97 —100
20,000	5	3/-	Peebles (Bruce) & Co., Ld., 6% Cm. P.	5	4¾— 5
65,000	1	—	Pooley (Henry) & Son., Ltd., Ord	1	3/- —4/-
13,000	5	—	Do. 5½% Cum. Pref.	5	2¾— 3
230,000	1	—	Projectile Co. (1902), Ltd., Ord.	1	9/16— 11/16
126,938	5	2/-	Rhymney Iron Co., Ltd.	5	1½— 2
73,062	5	2/-	Do. New	5	1 11/16— 1 13/16
£330,000	—	5%	Do. 5% Mort. Deb., Red.	100	99 —102
350,000	1	7½d.	Richardsons, Westgarth & Co., Ltd., 6% Cum. Pf.	1	15/16— 1
£350,000	Stk	4½%	Do. 4½% Perp. Deb. Stock	100	95 — 97
35,000	10	12/-	Ruston, Proctor & Co., Ltd.	10	9½— 9¾
275,000	1	6d.	Scott (Walter), Ltd., Ord.	1	⅞— 1
300,000	1	7½d.	Do. 6% Cum. Pref.	1	1— 1⅛
£300,000	Stk	4%	Do. 4% Perp. Deb. Stk.	100	94 — 96
£115,300	100	5%	Shelton Iron, Steel and Coal Co., Ld. 1st Charge 5% Debs., Red	100	90 — 93
£97,900	100	6%	Do. 6% 2nd Mort. Debs., Red.	100	91 — 95
250,000	1	1/-	South Durham Steel & Iron, Ltd. Or.	1	19/32— 21/32
300,000	1	7½d.	Do. 6% Cum. Pref.	1	13/16— ⅞*
£300,000	Stk	4½%	Do. 4½% Per. Deb. Stock	100	85 — 90
49,560	10	2½%	Steel Co. of Scotland Ord. 1/49560	9	5½— 5⅝
£125,240	Stk	—	Do. 5% Trust Mort. Deb.	100	106½—107½
25,000	10	—	Stephenson (Robert) & Co., Ltd., Or.	10	1½— 1⅞
25,000	10	5/6	Do. 5½% Cum. Pref.	10	4 — 4¼
£250,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	76 — 78
85,000	10	9/-	Stewarts & Lloyds, Ltd., Ord.	10	17¼— 17¾
55,000	10	6/-	Do. 6% Cum. Pref.	10	14 — 14½
634,732	1	4.69d.	Swan, Hunter & Wigham-Richardson, Lim. Ord.	1	⅞— 1
538,845	1	6d.	Do. 5% Cum. Pref.	1	⅞— 1
£240,000	Stk	4¼%	Do. 4¼% 1st Mort. Deb. Stk. Red	100	97 — 100
300,000	1	6d.	Thames Iron Works, Shipbuilding & Engineering Co., Ltd., 5% Cum. Pf.	1	½— 9/16
£200,000	100	4%	Do. 4% Irredeem. 1st Mort. Deb.	100	67 — 71
£160,000	1	7½d.	Thornycroft (John I.) & Co., Ltd. 6% Cum. Pref.	1	15/16— 1 1/16
10,000	10	5/-	Tylor (J.) & Sons, Ltd. 5% Cum. Pf.	10	9½— 10
$508495200	$100	$½	United States Steel Corp. Com. Stk.	$100	29¼— 29½
$360314100	$100	$1¾	Do. 7% Cum. Pref. Stock	$100	95 — 95¼
$162268000	$1000	5%	Do. 10-60yr. 5% Skg. Fd. G. Bds.	$1000	95 — 97
3,350,000	1	1/-	Vickers, Sons & Maxim, Ltd. Ord.	1	2 9/16— 2 11/16
750,000	1	6d.	Do. 5% Non-Cum. Pref.	1	1⅛— 1¼
£750,000	Stk	5%	Do. 5% Non-Cum. Pref. Stock.	100	114 —117
£1,250,000	Stk	4%	Do. 4% 1st. Mort. Deb. Stk. Red.	100	105 —107
£1,000,000	100	4½%	Do. 4½% 2nd Mort. Debs., Red.	100	104 —106
225,000	1	1/2⅝	Weardale Steel, Coal & Coke, Ltd., Def. Ord.	1	13/16— 15/16
500,000	1	7½d.	Do. 6% Cum. Pref. Ord.	1	⅞— 1
£300,000	Stk	4%	Do. 4% Perpetual Deb. Stock	100	85 — 89
7,637	5	2/9	Weldless Steel Tube, Ltd., Cum. Pref. 5½	5	4¾— 4⅞
300	Stk	4½%	Do. Mort. Deb. 4½%	100	91 — 97
66,666	5	3/.	Willans & Robinson, Ord.	5	1 — 2
66,666	5	3/-	Do. 6% Cum. Pref.	5	3 — 4
£246,641	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red	100	74 — 79
£150,000	Stk	4½%	Yorkshire Iron & Coal Co., Ltd., 4½% 1st Mort. Deb. Stk. Red.	100	80 — 85

Stocks and Shares marked * are quoted ex-dividend.

II.—ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
70,000	1	6d.	Alliance Elec. Co., Ltd. 5% Cum. Pf.	1	⅝— ⅞
125,000	1	7½d.	Aron Elec. Meter Ltd., 6% Cum. Pf.	1	7/16— 9/16
120,000	1	9⅜d.	Bell's Asbestos Co., Ltd.	1	11/16— 13/16
100,000	5	4/-	British Insulated & Helsby Cables Ltd., Ord. ..	5	5 — 5¼
100,000	5	3/-	Do. 6% Cum. Pref.	5	5¼— 5¾
£500,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Rd.	100	101 —104
£200,000	Stk	4½%	British Thomson-Houston Co., Ltd., 4½% 1st Mort. Deb. Stk. Red...	100	101 —103
400,000	5	3/-	British Westinghouse Electric and Manufac. Co., Ltd., 8% Pref...	5	2⅝— 2⅞
£616,353	Stk	4%	Do. 4% Mort. Deb. Stk. Red...	100	86 — 88
105,731	2	2/-	Brush Elec. Enging. Co., Ltd., Ord..	2	½— ¾
150,000	2	2/4½	Do. 6% Pref.	2	1¼— 1½
£125,000	Stk	4½%	Do. 4½% Perp. 1st Deb. Stk...	100	93 — 96
£125,000	Stk	4½%	Do. 4½% Perp. 2nd Deb. Stk.	100	74 — 77
35,000	5	5/-	Callender's Cable & Constn. Ltd. Ord.	5	9 10
40,000	5	2/6	Do. 5 % Cum. Pref.	5	5½-- 5⅝
£200,000	Stk	4½%	Do. 4½% 1st Mort. Deb Stk. Red.	100	104 —106
85,000	3	1/6	Crompton & Co., Ltd...	3	2 — 2¼
£100,000	—	5%	Do. 5% 1st Mort. Reg. Debs.	100	93 — 98
52,000	5	10/-	Dick, Kerr & Co., Ltd.. Ord. ..	5	8 — 8½
61,000	5	3/-	Do. 6% Cum. Pref.	5	5¾— 6
£300 000	Stk	4½%	Do. 4½% Deb. Stock, Red. ..	100	105 —107
233,334	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	1⅛— 1⅜
£233,334	Stk	4%	Do. 1st Mort. 4% Iree. Deb. Stk.	100	105 —108
99,261	5	1/6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	3	⅝— ⅞
17,139	5	2/6	Do. "A" Shares Nos. 01-017,139	5	1 — 1½
£344,023	Stk	4%	Do. 4% Deb. Stock Red. ..	100	78 — 83
£100,000	Stk	5%	Do. 5% Second Deb. Stk. Red.	100	79 — 84
112,100	2	1/7½	Electric Construction Co., Ltd. ..	2	1⅛— 1¼
31,890	2	2/9⅜	Do. 7% Cumulative Pref. ..	2	2¼— 2½
£200,000	Stk	4%	Do. 4% Perp. 1st Mt. Deb. Stk.	100	97 — 99*
10,248	10	7/6	Evered and Co., Ltd.	10	13 — 15
£100,000	Stk	5%	Ferranti, Ltd., 5% 1st Mort. Deb. Stock, Red...	100	90 — 95
25,000	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9½— 10
£200,000	Stk	4%	Do. 4% 1st. Mt. Deb. Stk.. Red.	100	91 — 96
35,000	5	5/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	10½— 11
35,000	5	2/3	Do. 4½% Cum. Pref... ..	5	5⅛— 5⅜
£250 000	Stk	4½%	Do. 4½% Mt. Deb. Stk. Red.	100	110 —112
50,000	10	5/-	India Rubber, Gutta Percha & Telegraph Works Co., Ltd.,	10	15 — 16
£300,000	100	4%	Do. 1st Mort. Deb. Red. ..	100	99 —102
7,500	10	—	Parker, Thos., Ltd.	10	6½— 7
100,000	1	8%	Scott (Ernest) & Mountain, Ld., Ord.	1	16/—16/6
37,350	12	12/-	Telegraph Construction and Maintenance Co., Ltd.	12	38 — 40
£150,000	100	4%	Do. 4% Deb. Bonds	100	101½-103½

III.—ELECTRIC TRACTION.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
120,000	5	3/-	Anglo-Argentine Trams Co., Ld., Or.	5	8¼— 8½
260,007	5	2/6	Do. 5% Cum Pf.	5	5 9/16— 5 11/16
£230,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888 ..	100	140 —143
20,000	10	6/-	Barcelona Trams Co., Ltd., Ord. ..	10	12 — 12½
10,000	10	5/-	Do. 5% Cum Pf. Shares	10	9 -- 10
£46,800	100	5%	Do. 5% Debs., Red. ..	100	99 -102
£191,326	Stk	4½%	Do. 4½% Red. Deb. Stk.	100	95 —100
75,606	1	—	Bath Elec. Trams. Ld., Pf. Or. ..	1	11/16— 13/16
59,394	1	11·49d	Do. 5% Cum. Pf. ..	1	⅞— 1
75,000	5	—	Brisbane Electric Tram Investment Co., Ltd., Ord... ..	5	1½— 2
75,000	5	2/6	Do. 5% Cum. Pf. ..	5	3¾— 4¼
£425,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	94 —98
£200,000	Stk	6%	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	100 —103
		%	Pref. Ord. Stock	100	100 —103
138,301	10	6/-	Brit. Electric Traction, Ltd., Ord.	10	9¾—10¼
156,437	10	6/-	Do. 6% Cum. Pref... ..	10	11⅛— 11⅜
£1,000,000	Stk	5%	Do. 5% Perp. Deb. Stk. ..	100	118 —120
£250,000	Stk	4½%	Do. 4% 2nd Deb. Stk. Red..	100	97 — 99
100,000	5	1/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	4 — 4½
40,500	5	3/-	Do. "A" 6% Cum Pref. ..	5	5⅞— 6⅜
27,000	5	3/-	Do. "B" do.	5	5⅝— 5⅞
£200,000	Stk	5%	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	94 — 97

ELECTRIC TRACTION.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	99 —102
102,268	5	3/-	Calcutta Tramways Co., Ltd. ..	5	8⅝— 8⅞
£350,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	106 —108
480,000	1	6d.	Cape Electric Tramways, Ltd. ..	1	1⅛— 1¼
40,000	5	2/6	City of Birmingham Trams Co., Ltd. 5 % Cum. Pref.	5	4⅞— 5⅛
£300,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	101 —104
155,000	5	4/-	City of Buenos Ayres Trams. Co., Ld.	5	10¼— 10½
£116,000	Stk	6%	Do. Per. 6% Deb. Stk...	100	140 —145
£120,000	Stk	5%	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	101 —104
60,000	10	6/-	Dublin United Trams. Co. (1896), Ltd., Ord. ..	10	13½— 14½
59,987	10	6/-	Do. 6% Pref...	10	15½— 16½
30,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	3½— 4
£150,000	Stk	4%	Do. 4% Deb. Stock.. ..	100	90 — 93
125,000	10	5/-	London United Trams. (1901), Ltd., 5% Cum. Pref.	10	10½—10¾
£1,031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	104 —106
£50,000	Stk	5%	Madras Electric Trams (1904), Ltd., 5% Deb Stock, Red.	100	101 —103
314,016	1	—	Metropolitan Elec. Trams, Ltd., Def.	1	½— ¾
500,000	1	6d.	Do. 5% Cum. Pref... ..	1	⅞— 1⅛
£350,000	Stk	4½%	Do. 4½% Deb. Stock, Red.	100	103 —105
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	½— 1½
110,923	8	2/9⅜	North Metropolitan Tramways Co..	8	4¾— 5¼
£150,000	100	3½%	Do. 3½% Mort. Debs.	100	90 — 95
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red..	100	101 —104
24,500	10	10/-	Potteries Elec. Traction Co., Ld., Or.	10	8 — 9
24,500	10	5/-	Do. 5% Cum. Pref. ..	10	8½— 9½
£220,000	Stk	4½%	Do. 4½% Deb. Stk., Red.	100	99 —102

IV.—ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	losing rices.
7,500	10	16/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. ..	10	12 — 12½
7,500	10	4/6	Do. 4½% Cum. Pref. ..	10	9½— 10
7,500	10	6/-	Do. 6% Cum. Second Pf. ..	10	11 — 12
£70,000	Stk	4½%	Do. 4½% Deb. Stock Red ..	100	103 —105
14,000	5	2/-	Bromley (Kent) Elec. Lt. & Pr. Co. Ld	5	5½— 5¾
£50,000	Stk	4½%	Do. do. 4½% 1st Deb. Stk. Red.	100	101 —104
27,507	5	4/6	Brompton & Kensington Elec. Supply Co., Ltd. Ord. ..	5	10½— 11
12,493	5	3/6	Do. 7% Cum. Pref. Shares..	5	10½— 10¾
60,000	5	3/-	Calcutta Elec. Sup. Cor. Ltd., Ord .	5	8½— 8¾
£288,782	Stk	4%	Central Elec. Sup. Co., Ltd., 4% Gua. Deb. S k. ..	100	105 — 108
70,000	5	4/-	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord... ..	5	8¼— 8¾
80,000	5	2/3	Do. do. 4½% Cum. Pref...	5	5⅜— 5⅝
£350,000	Stk	4%	Do. do. 4% Deb. Stk. Red.	100	101 —103
41,436	5	2/3	Chelsea Elec. Sply. Co., Ltd., Ord.	5	6¾— 7¼
£150,000	Stk	4½%	Do. do. 4½% Deb. Stk., Red	100	108 —110
70,595	10	5/-	City of London El. Lghtg. Co., Ld., O.	10	11½— 12
40,000	10	6/-	Do. 6% Cum. Pref. .. .	10	13½— 14
£400,000	Stk	5%	Do. 5% Deb. Stk., Red ..	100	121 —125
£300,000	Stk	4½%	Do. 4½% 2nd Deb. Stk., Red	100	101 —103
40,000	10	4/-	County of London Elec Supply Co., Ltd., Ord.	10	9 — 9½
30,000	10	6/-	Do. 6% Cum. Pref.	10	12 — 12½
£400,000	Stk	4½%	Do. 4½% Deb. Stk., Red. ..	100	107 —110
70,000	5	2/6	Edmundson's Elec. Cor. Ltd., Ord.	5	6¼— 6½
70,000	5	3/-	Do. 6% Cum. Pref.	5	6 — 6½
£300,000	Stk	4½%	Do. 4½% 1st Mort. Db. Stk. Reg	100	106 —108
£80,000	Stk	5%	Electric Lighting & Traction Co. of Australia, Ltd 5% Deb. Stk. Red.	100	86 — 91
10,000	5	2/-	Folkestone Elec. Supply Co., Ld., O	5	5½— 6
£50,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red	100	102 —105
15,000	10	—	Havana Electricity Co., Ltd... ..	10	9½—10½
18,000	5	3/6	Hove Elec. Lighting Co., Ltd., Ord	5	7½— 8
£50,000	Stk	4½%	Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock, Red.	100	100—102
150,000	1	—	Kalgoorlie Electric Power & Lighting Corp. Ltd., 6% Cum. Pref.	1	3/16— 5/16
21,000	5	5/-	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord. ..	5	12¾-- 13¼

Stocks and Shares marked * are quoted ex-dividend

ELECTRIC LIGHTING AND POWER.—*Contd.*

t t ed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
00	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	102 —104
00	3	—	London Elec. Supply Corp., Ld., Ord.	3	2¼— 2½
00	5	3/-	Do. 6% Pref.	5	$5\frac{9}{16}$— $5\frac{13}{16}$
95	Stk	4%	Do. 4% 1st Mort. Db. Stk., Red.	100	96 — 98
00	10	9/-	Metropolitan Elec. Sup. Co., Ld., Or.	10	17¾— 18¼
21	5	2/3	Do. 4½% Cum. Pref.	5	5½ — 5⅝
00	Stk	4½%	Do. 4½% 1st Mort. Db. Sk., Red.	100	110 —115
00	Stk	3½%	Do. 3½% Mort. Deb. Stk., Red.	100	96 — 98
00	—	4½%	Midland Elec. Corp. for Power Distribution. Ld., 4½% 1st Mort. Deb.	100	92 — 95
52	10	6/-	Notting Hill Elec. Ltg. Co. Ltd. Ord.	10	14½— 15
00	100	4%	Do. 4% 1st Mort. Debs. ..	100	102 —104
00	5	2/6	Oxford Electric Co. Ltd., Ord. ..	5	6⅛— 6⅜
00	Stk	4%	Do. 4% Debenture Stk. Red.	100	98 —100*
00	100	4½%	Royal Elec. Co. (of Montreal) 4½% 20-yr. 1st Mort. Deb	100	100 —102
00	5	5/-	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	13¾—14¼
00	5	3/6	Do. 7% Pref...	5	8½— 9
00	Stk	3½%	Do. 3½% Deben. Stock, Red	100	98 —100
00	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2¾— 3¼
00	Stk	4%	Do. 4% Debenture Stk Red.	100	83 — 87
00	5	3/-	South London Elec. Sup. Co., Ltd. O.	5	4⅛— 4⅜
00	1	—	South Metropolitan Elec Light & Power Co., Ltd. Ord.	1	⅞ — 1
00	1	8⅖d.	Do. 7% Cum. Pref.	1	1⅜— $1\frac{7}{16}$
00	Stk	4½%	Do. 4½% 1st Deb. Stock Red.	100	107 —110
00	5	2/6	Urban Electric Supply Co., Ltd., O.	5	5 — 5¼
00	5	2/6	Do. 5% Cum Pref.	5	$5\frac{1}{16}$—$5\frac{3}{16}$
00	Stk	—	Do. 4½% 1st Mort. Deb. Stk. Red	100	105 —107
00	5	6/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	13 — 13½
51	5	2/6	Do. 5% Cum. Pref.	5	6¼— 6¾

'ELEGRAPH & TELEPHONE COMPANIES.

t it ed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
00	100	4%	African Direct Tel. Co., Ld., 4% Mt. Debs. (Series A), Red.	100	99 —102
00	10	—	Amazon Telegraph Co., Ld... ..	10	¾— 1¼
80	Stk	12/6	Anglo-American Tel. Co., Ltd., Ord.	100	55 — 57
10	Stk	25/-	Do. 6% Preferred Ordinary	100	101 — 103
10	Stk	2/-	Do. Deferred Ordinary ..	100	10¾— 11
00	5	3/-	Chili Telephone Co., Ltd.	5	6⅛— 6⅜*
000	$100	$2	Commercial Cable Co., Capital Stk.	$100	170 —190
56	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	95 — 97
00	10	5/-	Cuba Submarine Tel. Co., Ld., Ord.	10	8¾— 9¼
00	10	10/-	Do. 10% Preference	10	16¾— 17½
00	5	2/-	Direct Spanish Telegraph Co., Ord.	5	3⅜— 3⅝
		5/-	10% Cum. Preference	5	7¾— 8¼
00	50	4½%	Do. 4½% Debs...	50	100-102%
0	20	3/-	Direct U.S. Cable Co., Ltd... ..	20	10⅝—10⅞*
00	100	4½%	Direct West India Cable Co., Ltd., 4½% Reg. Debs.	100	99 —101
00	100	4%	East. & S. African, Ld., 4% Mt. Db-.	100	101 —103
00	25	4%	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)..	25	100-102%
0	10	2/6	Eastern Extension, Australasia and China, Ltd...	10	13½— 14*
0	Stk	4%	Do. 4% Mort. Deb. Stk., Perp.	100	106 —108
0	Stk	25/-	Eastern Tele. Co., Ltd., Ord. ..	100	134 —137*
0	Stk	17/6	Do. 3 % Pref.	100	87 — 89*
4	Stk	4%	Do. 4% Mort. Deb.	100	105 —107
0	10	5/-	Great Northern Telegraph Co., Ltd., (of Copenhagen) ..	10	29 — 29½
0	100	4½%	Halifax and Bermudas Cable Co., Ltd., 4½% 1st. Mort. Debs. Red.	100	99 —101
0	25	12/6	Indo-European Tele. Co., Ltd. ..	25	45 — 47
0	1	7½d.	Monte Video Telephone Co., Ltd., O.	1	$\frac{13}{16}$— $\frac{15}{16}$
3	Stk	6%	National Telephone Co., Ltd., Pref.	100	108½—109½
7	Stk	5%	Do. Deferred	100	108—110
0	5	2/6	Do. 5% Non-Cum. 3rd Pref.	5	5¼ — 5½
0	Stk	3½%	Do. 3½% Deb. Stk., Red. ..	100	96 — 98
3	Stk	4%	Do. 4% do. do. ..	100	101 —103
3	1	7½d.	Oriental Telephone & Elec. Co., Ltd.	1	1 — 1⅛
0	1	7½d.	Do. 6% Cum. Pref.	1	1⅛— 1¼
0	100	4%	Pacific & European Tel. 4% Guar. Debs. Red...	100	96 — 99
9	8	4/-	Reuter's Telegram Co., Ltd. ..	8	7 — 7½
0	5	3/-	United River Plate Telep. Co., Ltd.	5	6½— 6¾
0	5	2/6	Do. 5% Cum. Pref.	5	6 — 5¼
7	Stk	5%	Do. 5% Deb. Stock, Red. ..	100	104—106
9	10	4/-	W. African Telegraph Co., Ltd. ..	10	7¼— 7¾
8	2½	—	West Coast of America, Ltd. ..	2½	½— ⅝
0	100	4%	Do. 4% Deb. Guar. by West. Tel.	100	98 — 100

TELEGRAPHS AND TELEPHONES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
88,321	10	6d.	W. India & Panama Teleg. Co., Ld., Or.	10	⅝— ¾
34,563	10	6/-	Do. 6% Cum. 1st. Pref. ..	10	7⅝— 7⅞
4,669	10	6/-	Do. 6% Cum. 2nd Pref. ..	10	6¾— 7¼
£80,000	100	5%	Do. 5% Deb.	100	101 —103
207,930	10	3/-	Western Telegraph Co., Ltd. ..	10	13½— 14
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	101 —103
518,945	Stk	4%	Do. 4% Deb. Stock, Red. ..	100	100½—102½

VI.—SHIPPING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
32,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 5½% Cum. Pref.	10	8½— 9
£325,000	Stk	4½%	Do. 4½% Red. 1st Mort. Deb. Stk.	100	99 —101
£672,900	Stk	4½%	British & African Stm. Nav. (1900) Ltd., 4½% 1st Mort. Deb. Stk., Red.	100	91 — 93
40,000	10	5/6	Bucknall Steamship Lines, Ltd., 5½% Cum. Pref.	10	6 — 6½
£600,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk.	100	73 — 76
£750,000	Stk	4½%	Clan Line Steamers, Ltd., 4½% Deb. Stk. Red. ..	100	98 —100
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000..	20	13 — 13½
40,000	20	8/-	Do. Nos. 60,001-100,000	10	5¾— 6¼
£461,430	Stk	4½%	Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. ..	100	101 —103
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord...	1	1⅛— 1¼
25,328	7½	4/7	Gen. Steam Navigation Co., Ld., Ord.	7½	4¼— 4¾
36,758	8	4/9⅗	Do. Non-Cum. 6% Pref.	8	7¼— 7¾
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	97 — 99
55,000	5	1/3	Houlder Line, Ltd., Ord.	5	3 — 3½
40,000	5	2/9	Do. 5½% Cum. Pref.	5	3¼— 3¾
£200,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk. Red.	100	83 — 86
141,500	10	5/-	Leyland (Fredk.), & Co., (1900), Ltd., 5% Cum. Pref. ..	10	4½— 5
£1,160,000	Stk	5 %	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. ..	100	126 —129
£1,160,000	Stk	19%	Do. do. Deferred ..	100	217 —220
15,000	100	30/-	Royal Mail Steam Packet Co. Ord..	60	26 — 27
39,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref..	5	4¾— 5¼
39,075	5	2/6	Do. "B" Ord...	5	4 — 4½
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord..	10	8 — 8½
24,000	10	4/6	Do. 4½% Cum. Pref... ..	10	9¾— 10¼
£1,008,894	Stk	4%	Do. 4% Debenture Stk., Red.	100	99 —101

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
60 000	1	9⅗d.	Chadburn's (Ship) Tele. Ltd., Ord...	1	⅞— 1⅛
£750,000	Stk	5%	General Hydraulic Power Co., Ltd.	100	138 —143
12,500	10	10/-	Oakey (John) and Sons, Ltd., Ord..	10	24 — 26
10,000	10	6/-	Do. do. 6% Cum. Pf.	10	14 — 15
183,538	1	6·3d.	Power Gas Corp., Ltd., Ord., Nos. 66,463-250	15/-	$\frac{5}{16}$— $\frac{7}{16}$
66,462	1	8·4d.	Do. do. Nos. 1 66,462	1	$\frac{9}{16}$— $\frac{11}{16}$
135,000	1	6d.	Waygood (R.) & Co., Ltd., Ord. ..	1	$1\frac{1}{16}$— $1\frac{3}{16}$
135,000	1	7⅕d.	Do. 6% Cum. Pref. ...	1	1⅛— 1¼*

RAILWAY CARRIAGE & WAGON COMPANIES.

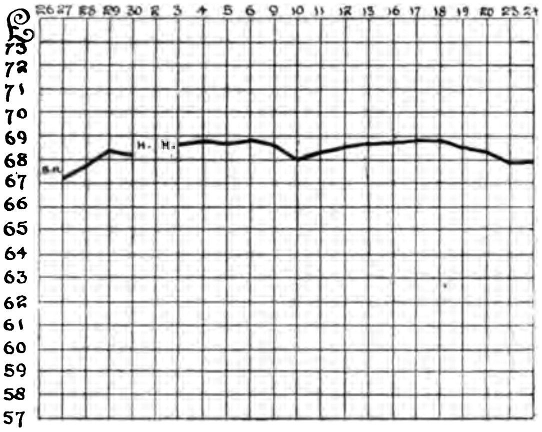
Present Amount Subscribed,	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices
10,000	10	7/6	Birm. Railway-Car, & Wagon, L., 1-10,000	10	21 — 21½
8,739	10	3/-	Do. Second Issue 1-8,739 ...	4	8¼— 8¾
10,000	10	6/-	Do. Cum. Pref. 6% 1-10,000..	10	13 — 13½
30,111	7	7/-	Gloucester Rail.-Car & Wagon, Ld., A, 1-29,861 & 49,751-50 000	7	9 — 9½
44,889	7	3/6	Do. B, 29,862-49,750, 50,001-75,000	7	4 — 4½
784,808	1	9d.	Metropolitan Amalgamated Rail.-Carriage & Wagon, Ld., 1-784,808	1	39/6— 39/9
164,288	1	6d.	Do. Cum. A Pref. 5% 1-164,288	1	23/6 —24/6
235,000	1	7½d.	Do. Cum. B Pref. 6% 1-235,000	1	27/9 —28/3
20,000	20	20/-	Midland Rail.-Car. & Wagon, Ld., 1-20,000	10	19 — 20
10,000	20	7½d.	Do. Pref. 6 per cent. 1-10,000		22/3— 22/9

Stocks and Shares marked * are quoted ex-dividend.

THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM DECEMBER 27TH, 1904, TO JANUARY 24TH, 1905.

COPPER.



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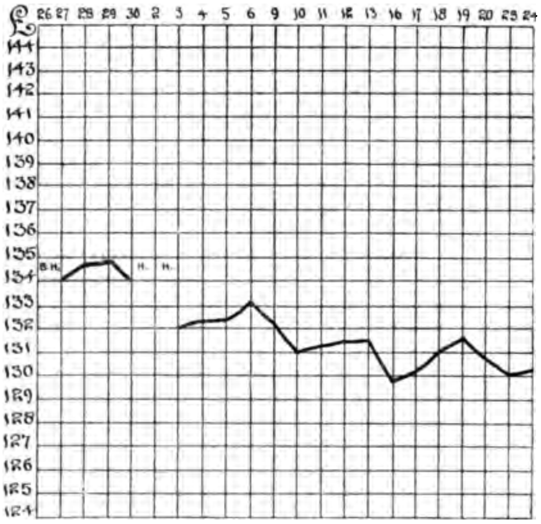
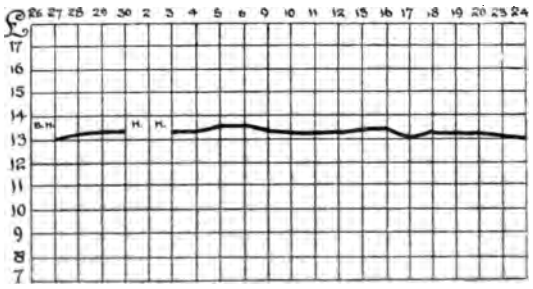


ENGLISH LEAD.



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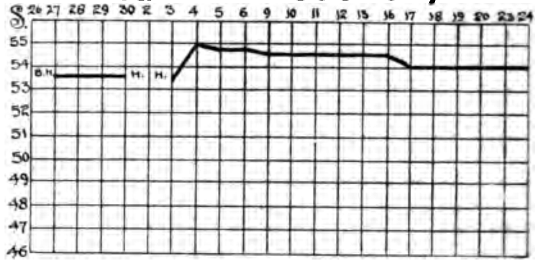

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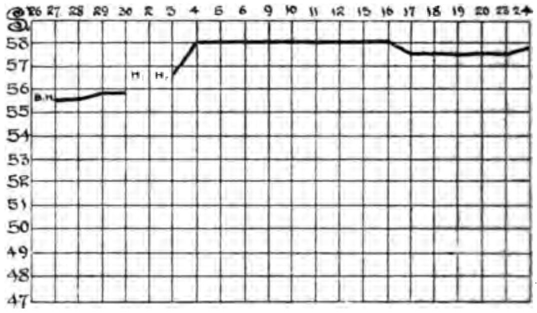
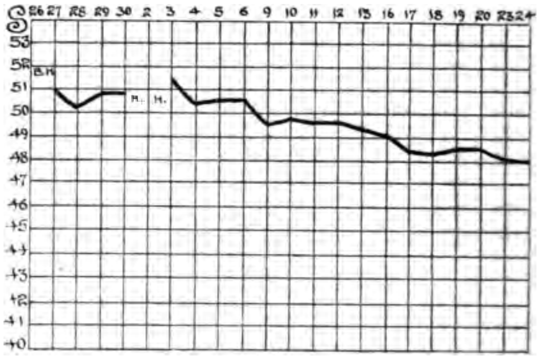


CLEVELAND.



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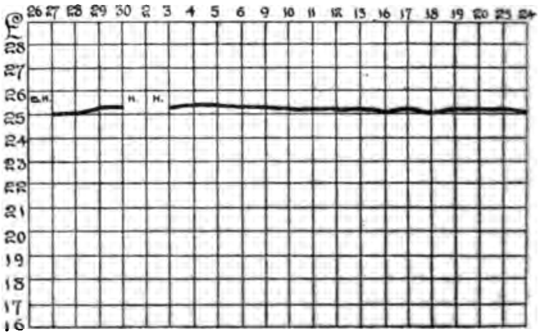


PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

MARKET REPORT.

Wednesday, January 25th, 1905.

THE copper market has been in the grip of speculative influences, and the frequent changes in quotations have been rather due to efforts to manipulate the market, than to fresh developments in connection with the position of the metal itself. Reference was made last week to the bare condition of the market, and it is difficult to see what is to stop the rise in quotations. In view of the increased trade activity in the United States, it is anticipated the consumption will reach 20,000 tons per month against 16,000 tons last year, while the European consumption is also increasing. Surplus stocks in the States are already exhausted, and those held in England and France represent no more than three weeks' consumption. The copper market is therefore trading on the smallest margin; and the scarcity of the metal appears likely to continue. The Amalgamated Company has again raised the price of electro, but our market yesterday closed rather easier.

Tin has been quiet, and lower Eastern advices assisted the efforts of dealers to depress the market pending the Banca sale. Three months' tin at one time was sold down to £129 15s., but the latest prices are better, best Foreign at £130 5s. cash, and £130 three months.

Lead is easier in tendency, the large arrivals checking the tendency towards the rise in quotations which has manifested itself more than once latterly. The close yesterday was £12 13s. 6d. Foreign, and £12 17s. 6d. English.

Spelter has had a temporary slight set-back, speculators for the rise finding an unwilling market when it came to realisations. This, however, was a mere phase and a recovery quickly followed. Consumers still have to deal with a depleted market.

In the Iron and Steel sections the Glasgow market has exhibited considerable activity. There has been a swerve in quotations due to the weeding out of the weak bull element, but speculative support was soon forthcoming, and the market once more hardened, although the latest tendency is again towards flatness. Outside the speculative market, the reports from trade centres point to improving business, particularly in shipbuilding materials and other heavy lines.

IRON, STEEL, PIG-IRON, &c.

SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as follows. Prices delivered in Glasgow or equal:—

	£	s.	d.
Steel:			
Siemens' Steel Plates, Marine Boiler Quality	6	15	0
,, ,, ,, Land ,, ,,	6	17	6
,, ,, ,, Ship Quality Plates	5	17	6
Siemens' Steel Bars, Boiler Quality	6	17	6
,, ,, ,, Ship ,,	6	7	6
,, ,, Angles	5	7	6
Manufactured Iron:			
Bars—Dalzell	6	2	6
,, Best	6	12	6
,, ,, Horseshoe	6	12	6
,, Angle	6	2	6
,, Best Angle	6	12	6
,, Best Best	7	2	6
,, Extra Best	7	12	6

Usual terms and extras. Special rates for delivery in England and export. The above prices subject to alteration without notice.

The Glasgow Iron and Steel Co., Ltd., Wishaw, quote as under (prices are delivered Glasgow or equal):—

	£	s.	d.	
Steel Angles (Glasgow ♕ Steel)	5	8	9	per ton.
Steel Ship Plates (Glasgow ♕ Steel)	5	18	9	,,
Steel Bars, Ship Quality (Glasgow ♕ Steel)	6	8	9	,,
Steel Bars, Boiler Quality (Glasgow ♛ ♛ Steel)	6	18	9	,,
Steel Land Boiler Plates (Glasgow ♛ ♛ Steel)	6	7	6	,,
Steel Marine Boiler Plates (Glasgow ♛ ♛ Steel)	6	7	6	,,

Less 5 per cent. discount. Extras as per standard list.

Special prices for delivery in England and for export. The above prices subject to alteration without notice.

John Spencer (Coatbridge), Ltd., Phœnix Ironworks, Coatbridge, N.B., quotes:—

	£	s.	d.
Bars—Phœnix	6	5	0
,, Best	6	15	0
,, Best Best	7	5	0
,, Extra Best	7	15	0
,, Best Horse Shoe	6	15	0
,, Extra B.H.S.	7	15	0
,, Extra Best Cable	8	5	0
,, Rivet	6	5	0
,, Best Scrap Rivet	7	5	0

	£	s.	d.
Angles—Phœnix	6	5	0
,, Best	6	15	0
,, Extra Best	7	5	0
Gas Tube Hoops—Phœnix Best	6	15	0
Plates—Phœnix	—		
,, Best Boiler	7	10	0
,, Best Best Boiler	8	0	0
,, Extra Best Boiler	9	0	0
Boiler Tube Strips—Phœnix Best Best	8	0	0

All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly.

Messrs. R. Feldtmann and Co., of Glasgow, quote Commission extra).

Pig Iron:

	No. 1.			No. 3.		
	£	s.	d.	£	s.	d.
Coltness, f.a.s. Glasgow	3	5	0	2	15	0
Gartsherrie ,,	2	19	6	2	14	6
Summerlee ,,	3	0	6	2	15	0
Carnbroe ,,	2	17	6	2	14	0
Langloan ,,	3	4	0	2	16	0
Calder ,,	2	19	0	2	14	6
Clyde ,,	2	19	0	2	14	6
Glengarnock, f.o.b. Ardrossan	2	19	0	2	13	6
Eglinton ,, ,,	2	15	6	2	13	0
Dalmellington ,, Ayr	2	15	6	2	13	0
Shotts ,, Leith	2	19	0	2	14	6

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, **at works:—**

	£	s.	d.
W.W. ♛ Bars	6	12	6
W.W. Best Bars	7	2	6
W.W. Best Best	7	12	6
W.W. Best Best Best	8	2	6
W.W. Best Shoe	7	2	6
Thornaby ♛	8	2	6
Thornaby Best	8	12	6
Thornaby Best Best	9	12	6
Whitwell Special Admiralty Cable	10	5	0
Special Chain Iron	9	5	0
Tube and Nail Strips	6	15	0
W.W. ♛ Angle Iron	6	15	0
W.W. Best Angle Iron	7	5	0
Tee Iron, to 8-inches United	7	12	6

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington, quote:—

	Iron.			Steel.		
	£	s	d.	£	s.	d.
Crown (BNF) Bars	6	10	0	7	0	0
,, ,, Angles	7	0	0	7	10	0
,, ,, Tees	7	10	0	8	0	0
,, (WIW) Hoops	7	0	0	7	10	0
,, ,, Sheets	7	10	0	8	0	0

Ordinary Sizes, F.A.S. Liverpool in 10-ton Lots.
Extras for Sizes and Cutting as per List.

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

Black Sheets:	Singles 20 G 96in. by 36in. per ton.			Doubles 21 G to 24 G 96in. by 36in. per ton.		
	£	s.	d.	£	s.	d.
"Vale"	10	0	0	10	10	0
"Shield"	10	10	0	11	10	0
"Severn"	11	10	0	12	10	0
"Baldwin Wilden B."	12	10	0	13	10	0
Charcoal	16	10	0	17	10	0
Best Charcoal	18	10	0	19	10	0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:	£	s.	d.	£	s.	d.
No. 3 Lead	13	10	0	14	10	0
S.V. Lead	15	0	0	16	0	0
No. 3 Terne	15	0	0	16	0	0
S.V. Terne	16	10	0	17	10	0

Tinned Sheets:	Singles 20 G to 108 by 36in. per ton.			Doubles 21 to 24 G to 96 by 36in. per ton.		
	£	s.	d.	£	s.	d.
Best Coke (Finish)	28	0	0	29	10	0
,, Charcoal (Finish)	30	0	0	31	10	0
Extra ,, ,,	32	0	0	33	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.

Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box.

Extreme sizes in Tin and Patent Coated specially quoted for.

Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.

At works less 2½% for cash monthly, 10th inst.

Galvanized Corrugated Sheets:

	£	s.	d.	
"Phœnix" Brand, 24 G., f.o.b. London, in Bundles	11	15	0	per ton.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	14	7	6	,,

Galvanized Working Up-Sheets:

	£	s.	d.	
24 G., f.o.b. London, in Bundles	13	15	0	per ton.

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£	s.	d.	
Crown Bars	6	10	0	per ton.
Best Bars (1 to 6in. wide, above ½ in. thick, ½ in. to 4 rounds and squares)	7	0	0	,,
Angles	6	15	0	,,
,, Best	7	5	0	,,
T's	7	0	0	,,
,, Best	7	10	0	,,
Best Shoe Iron	8	0	0	,,
,, Rivet Iron	8	0	0	,,
,, Best Rivet (Special)	9	5	0	,,
,, Cable	9	5	0	,,
,, Screwing	8	5	0	,,

	£	s.	d.	
Best Turning	8	0	0	per ton.
,, Plating	8	5	0	,,
,, ,, Best Best	9	5	0	,,
,, ,, Treble	10	5	0	,,
Plates	7	10	0	,,
Best Plates	8	0	0	,,
,, Boiler Plates	8	10	0	,,
,, Best Boiler Plates	9	10	0	,,
Treble Best Boiler Plates	12	0	0	,,

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon., quote "Star" brand patent wrought nails, steel nails, &c.

Discounts—

45 per cent. off 1-inch to 3-inch strong rose and all fine rose and 6dy. and 8dy. pound.

40 per cent. off 3½ inch to 7-inch strong rose and 10dy. and 20dy. pound.

40 per cent. off all sharp-pointed nails.

Delivered in lots of 4 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis :—

2 tons 9/6 per cwt.
4 cwt. lots and upwards 9/9 per cwt. } d/d any Railway Station.

Steel cut nails, 3-inch basis—
2 tons 8/3 per cwt.
4 cwt. lots 8/6 per cwt. } d/d any Railway Station.

Slit rods (iron) £7 10s. per ton, at works for 2-ton lots.

Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E. C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla, quote :—

	Per Box. f.o.b. Wales. £	s.	d.
Coke Tin-plates.			
C 18¾ by 14 124s. 110 lb. "BV"	0	13	0
C 20 by 10 225s. 155 ,, "Jumbo"	0	18	3
C 20 by 14 112s. 108 ,, "Lydbrook"	0	12	6
C 28 by 20 112s. 216 ,, "Lydbrook"	1	5	3
Charcoal Tinplates:			
C 20 by 14 112s. 108 lb. "Allaway"	0	13	3

BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes :—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

Steel:	£	s.	d	
Blooms	at 3	12	0	per ton.
Billets	at 3	14	0	,,
Sheet Bars	at 3	16	0	,,
Finished Steel:				
Bars	at 4	17	6	per ton.
Angles	at 4	18	6	,,
Tees	at 5	2	0	,,
Joists	at 4	10	0	,,
Fencing Standards	at 5	2	0	,,
Shoeing Bars	at 5	4	0	,,
Tyre Bars	at 5	4	0	,,
Half-Round Bars	at 5	5	0	,,
Heavy Rails	at 4	10	0	,,
Light Rails	at 4	17	6	,,

Structural Steelwork:

Prices on application.

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote :—

TIN.

Tin:	£	s.	d.		£	s.	d.	
English Ingots, f.o.b. Dis. 1¼% & 1%	131	0	0	to	131	10	0	per ton.
English Bars, f.o.b. Dis. 1¼% & 1%	132	0	0	to	132	10	0	,,
Straits G.M.B., cash Warehouse, Net	130	0	0	to	130	5	0	,,
Straits G.M.B., 3 months, Warehouse, Net	129	15	0	to	130	0	0	,,
Australian, Mr. Bischoff, Warehouse, Net	130	15	0	to	131	0	0	,,

COPPER.

Copper:	£	s.	d.		£	s.	d.	
Standard G.M.B., cash Warehouse, Net	67	15	0	to	68	0	0	per ton.
Standard G.M.B., 3 months, Warehouse, Net	67	15	0	to	68	0	0	,,
English, Tough, Cake & Ingot, Warehouses, Net	70	10	0	to	71	0	0	,,
English, Best Select, Warehouse Net	71	10	0	to	72	0	0	,,
English, Sheets and Sheathing, f.o.b., Dis. 2½%	80	0	0	to	80	10	0	,,
English, Sheets for India, f.o.b., Dis. 2½%	76	0	0	to	76	10	0	,,
Electro, Warehouse, Net	70	15	0	to	71	0	0	,,
Ore, ex. ship	0	12	0	to	0	13	0	per unit.
Regulus, Matte and Precipitate, ex. ship,	0	13	3	to	0	14	0	,,

YELLOW METAL.

Yellow Metal:

	£	s.	d.	£	s.	d.	
Sheets, 4 by 4 feet for India f.o.b. Dis. 2½%				0	0	6¾	per lb.
Sheathing ,, ,,				0	0	6⅞	,,

SPELTER;

	£	s.	d.		£	s.	d.	
Silesian outports, Net	24	15	0	to	25	0		per ton.
Blende of 50% Net	7	0	0	to	7	10		,,
Calamine, Net	7	2	6	to	7	12		,,

LEAD.

	£	s.	d.		£	s.	d.	
English Pig, Warehouse, Dis. 2½%	13	0	0	to	13	2	6	per ton.
Spanish, ex ship, Dis. 2½%	12	15	0	to	12	17	6	,,
Lead Ore of 70%, Net	6	12	6	to	6	15	0	,,

ANTIMONY.

	£	s.	d.		£	s.	d.	
Star Regulus, f.o.b., Dis. 2½%	36	10	0	to	37	0	0	per ton.
Ore, 50%, ex ship, Dis. 2½%	8	0	0	to	9	0	0	,,
Crude, ex ship, Dis. 2½%	13	10	0	to	14	0	0	,,

QUICKSILVER.

	£	s.	d.	
Spanish, 75 lb., Warehouse, Net	7	15	0	per flask.
Italian ,, ,, ,,	7	14	0	,,

COAL.

LEICESTERSHIRE.

The Nailstone Colliery Company, Leicester, quote. Price per Ton at Pit of 20 Cwt., with ½ Cwt. per Ton for wastage —

Upper Main Seam.	s.	d.
Main Coal	7	6
Best Hard Steam (hand picked, as used by the Railway Companies)	6	0
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)	6	0
Fine Slack	0	6

Terms, net cash on 10th of month following delivery.

DERBYSHIRE.

The Manners Colliery Co., Ltd., of Ilkeston quote as follows, per ton at pit:

Kilburn Coal:	s.	d.
Best London Brights	9	9
Large Nuts (1½ to 3½)	9	6
Small Nuts (⅜ to 1½)	6	0
Rough Brights	6	0
Peas (⅜ to ⅝)	5	0
Slack	3	6
Smudge	2	0

Low Main (or Tupton) Coal:	s.	d.
Low Main Brights	7	6
,, ,, Nuts	7	3
Hards (Good Steam Coal)	8	0
Bakers' Nuts (1" to 2")	6	6
Slack	3	6

The Clay Cross Company's Collieries, Clay Cross, near Chesterfield, quote:—

	per ton at pit. s.	 d.
Best Main Coal	10	6
Best Silkstone	10	0
Best House Coal	8	6
Best House Nuts	8	0
Treble Screened Cobbles	7	9
Best Cobbles	7	3

NOTTINGHAMSHIRE.

The Digby Colliery Co., Ltd., near Nottingham, quote per ton at pit :—

Digby Coal:

STEAM.	s.	d.
Best Hand Picked Hard	9	0
Steam Hard	7	9
Hard Nuts	7	0

Gedling Colliery.

HIGH HAZEL.		
London Brights, 4 to 8 in. cube	12	0
Large Nuts, 2 to 4 in. cube	9	6
Small Nuts, ¾ to 2 in. cube	5	6

STEAM.—TOP HARD.		
Best Hard	9	0
Hard Steam	8	0
Cobbles	7	0

CHEMICALS AND OILS.

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square, Manchester, quote:

	£	s.	d.	
Acids: Oxalic	0	0	2¼	per lb.
Picric, Crystals	0	0	11	,,
Tartaric at Manchester	0	0	10⅞	,,

	£	s.	d.	
Acetate of Lime: Brown at Manchester net	8	15	0	per ton.
Grey ,,	11	0	0	,,
Alumina: Alum, Lump, loose	5	5	0	,,
,, ,, in casks	5	7	6	,,
,, Ground, in bags	5	15	0	,,
Sulphate of Alumina, 14%	4	10	0	,,
Ammonia: Carbonate	0	0	3⅝	per lb.
Muriate Grey f.o.b. Liverpool	24	0	0	per ton.
Sal-ammoniac, Lump, 1sts, del$^{d.}$ U.K.	42	0	0	,,
,, ,, 2nds, ,,	40	0	0	,,
Sulphate f.o.b. Liverpool	13	2	6	,,
Arsenic: Best White Powdered net	12	0	0	,,
Bleaching Powder, 35% ,,	4	10	0	,,
Borax: British Refined Crystal ,,	12	0	0	,,

Coal Tar Products:	£	s.	d.	
Benzole, 50/90 % ,,	0	0	8¼	per gal.
,, 90% ,,	0	0	10	,,
Carbolic Acid Crystals, 34/35° C. ,,	0	0	6⅞	per lb.
,, ,, ,, 39/40° C. ,,	0	0	7⅛	,,
,, ,, Liquid, 97/99 % ,,	0	0	9	per gal.
,, ,, Crude, 62½% at 60° F. f.o.b. ,,	0	2	0	,,
Creosote, ordinary good liquid ,,	0	0	1¼	,,
Naphtha, Crude, 20 % at 120° C. ,,	0	0	3	,,
,, Solvent, 90% at 160° C.f.o.b ,,	0	0	8½	,,
,, ,, 95 % at 160° C. ,, ,,	0	0	9½	,,
,, ,, 90 % at 190° C. ,, ,,	0	0	10½	,,
,, Rectified, flash point over 73° F. f.o.b. ,,	0	0	11	,,
,, Rectified, flash point over 100° F. f.o.b. ,,		1	0	,,
Naphthalene, all qualities.				
Pitch f.a.s. Manchester. ,,	1	12	0	per ton.
Copperas: Green, in bulk ,,	0	12	6	,,
,, barrels f.o.b. L'pool ,,	1	19	0	,,
Cake ,,	1	2	6	,,
Copper: Sulphate	23	0	0	,,
Cyanides: 98% minimum f.o.b. net	0	0	8	per lb.
Lead: Acetate (Sugar) White, English	27	10	0	per ton.
,, ,, ,, Foreign c.i.f. U.K	24	5	0	,,
,, ,, Grey	21	15	0	,,
,, ,, Brown at Manchester	16	10	0	,,
Nitrate	24	0	0	,,
Litharge, Flake	15	10	0	,,
,, Powder	16	0	0	,,
Red Lead, Genuine, c.i.f. London less 5%	15	10	0	,,
White ,, ,, Dry ,, ,, ,,	16	15	0	,,
Naphtha (Wood): Miscible, 60 o.p.	0	2	10	per gal.
Solvent	0	2	7	,,
Potash: Bichromate... delivered England	0	0	3	per lb.
Carbonate, 90/92 % ... c.i.f Hull	18	0	0	per ton.
Caustic, 75/80 % ,, ,,	20	10	0	,,
Chlorate net	0	0	3 1/16	per lb.
Montreal in Store, Liverpool	35	0	0	per ton.
Prussiate, Yellow net	0	0	4 11/16	per lb.

	£	s.	d.	
Soda: Ash, Caustic, 48 %, Ordinary ... ,,	5	5	0	per ton.
,, ,, ,, Refined...... ,,	6	5	0	,,
,, Carbonated, 48 %............ ,,	5	10	0	,,
,, ,, 58 % (Ammonia Alkali) ....net	4	10	0	,,
,, Bleachers' Refined Caustic 50/52 % .... net	6	10	0	,,
Caustic, White, 77 %............... ,,	10	10	0	,,
,, ,, 70 %............... ,,	9	12	6	,,
,, ,, 60 %............... ,,	8	12	6	,,
,, Cream, 60 %..... .... ,,	8	10	0	,,
Crystals, in bags	3	0	0	,,
,, barrels	3	7	6	,,
Acetate .... c.i.f. Hull net	16	10	0	,,
Bicarbonate, in 1 cwt. kegs............	6	15	0	,,
Bichromate......delivered England...	0	0	2¼	per lb.
Chlorate .... net	0	0	$3\frac{1}{16}$	per lb.
Nitrate ..ex quay Liverpool, ... ,,	11	0	0	per ton.
Phosphate	9	5	0	,,
Prussiate ....net	0	0	3⅝	per lb.
Silicate, Solution, 140° Tw.	4	10	0	per ton.
Sulphate (Glauber Salts)..............	1	12	6	,,
,, (Saltcake, 95%)..............	1	15	0	,,
Sulphur: Recovered	4	15	0	,,
Roll	6	15	0	,,
Flowers..................................	7	10	0	,,
Zinc: Sulphate	6	15	0	,,

MINERALS.

	£	s.	d.	
Barytes: Lump Carbonate, 90/92%	3	10	0	per ton.
Sulphate, No. 1, White	2	15	0	,,
China Clay: of various qualities for all purposes; prices from about 11/- to about 30/- per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid.				
Chrome Ore: Basis 50% c.i.f. British Ports..........	3	7	6	,,
Manganese: Lump c.i.f. Liverpool 10¼d.	per metallic unit.			
Ochre: French JC .... f.o.b. Rouen, net	2	5	0	per ton.
,, JF	5	10	0	,,
Talc: (French Chalk).........c.i.f. Liverpool	3	10	0	,,

OILS, etc.

	£	s.	d.	
Aniline Oil ....net	0	0	4¾	per lb.
,, **Salt**.......... .... ,,	0	0	4½	,,
Castor Oil: French, 1st pressure, f.o.b. Marseilles less 1½%.........	23	0	0	per ton.
English, 1st pressure, f.o.r. Hull, less 2½%...............	24	0	0	,,
Cocoa Nut Oil: Ceylon, ex store Manchester...............net	29	10	0	,,
Cochin, ex store Manchester . ...net	32	0	0	,,
Cotton Seed Oil: Refined at Hull, less 2½% naked	12	15	0	,,
Edible...at Hull, less 2½% naked	13	5	0	,,
Glycerine: Crude, 80% .... net	31	0	0	,,
Linseed Oil: Raw... ..at Hull, less 2½% naked	12	15	0	,,
Boiled......at Hull less 2½% naked	13	15	0	,,
Starch: American Pearl...at Manchester, net	9	0	0	,,
Dextrine........... ,, ,,	18	0	0	,,
Farina............... ,, ,,	15	15	0	,,
Shellac: Standard TN orange spot.........	150/-			per cwt.
Turpentine: American.........at Liverpool	38	10	0	per ton.
Russian ....at Hull...net	18	10	0	

TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote:—

COLONIAL WOODS.

Timber.

		£	s.	d.		£	s.	d.
Quebec Square White Pine...	per cub. ft.	0	1	9	to	0	3	0
Quebec Waney Board Pine...	,,	0	2	8		0	3	9
St. John Pine, 18 in. average	,,	0	2	3		0	3	3
Lower Ports Pine	,,	0	1	8		0	1	8
Quebec Red Pine	,,	0	1	6		0	2	0
Quebec Oak, 1st quality	,,	0	2	9		0	3	3
Quebec Oak, 2nd quality ...	,,	0	1	6		0	2	6
Ash	,,	0	1	6		0	2	3
Elm	,,	0	3	0		0	3	9
Hickory	,,	0	2	0		0	2	6
Quebec Birch	,,	0	1	6		0	2	3
St. John Birch	,,	0	1	6		0	2	0
Birch Planks.....................	,,	0	0	9		0	0	11
Spruce Spars	,,	0	0	10		0	1	0

Deals.

		£	s.	d.		£	s.	d.
1st quality Quebec Pine	per std.	22	10	0	to	32	10	0
2nd do. do.	,,	17	0	0		22	0	0
3rd do. do	,,	11	10	0		13	0	0
St. John, N.B., etc., Spruce	,,	6	10	0		6	15	0
Lower Ports Spruce..	,,	6	0	0		6	10	0
Spruce Boards.................	,,	5	10	0		6	0	0

UNITED STATES, etc., WOODS.

Pitch Pine.

		£	s.	d.		£	s.	d.
Hewn	per cub. ft.	0	1	3	to	0	1	8
Sawn	,,	0	0	10		0	1	6
Planks, Stowage	,,	0	0	10		0	1	0
Boards, Prime	per std.	12	10	0		16	0	0
Oak Timber	per cub. ft.	0	1	6		0	2	6
Oak Planks	,,	0	1	6		0	2	1
East India Teak..............	per load	12	0	0		15	0	0
Greenheart.....	,,	6	15	0		7	10	0

EUROPEAN WOODS.

Timber.

		£	s.	d.		£	s.	d.
Riga Redwood	per cub. ft.	0	1	9	to	0	2	3
Dantzic and Memel Fir, Crown	,,	0	2	1		0	2	6
Dantzic and Memel Fir, Middling	,,	0	1	9		0	1	11
Stettin	,,	0	1	9		0	1	11
Swedish....................... ...	,,	0	1	2		0	1	4
Riga Whitewood	,,	0	1	3		0	1	6
Norway Mining Timber	,,	0	0	9		0	0	10
Dantzic and Stettin, etc., Oak..	,,	0	2	6		0	3	0
Norway Spars.................	,,	0	1	2		0	1	9

Deals.

		£	s.	d.		£	s.	d.
Red Archangel and Onega, 1st quality	per std.	19	0	0		21	0	0
Red Archangel and Onega, 2nd quality	,,	16	0	0		17	0	0
Red Archangel and Onega, 3rd quality	,,	12	10	0		15	0	0
St. Petersburg, 1st quality...	,,	16	0	0		17	10	0
Do. 2nd ,, ...	,,	14	0	0		15	0	0
Gefle	,,	14	0	0		17	10	0
Wyburg	,,	12	0	0		13	10	0
Uleaborg	,,	12	0	0		13	10	0
Gothenburg	,,	14	0	0		17	10	0

SELECTED PATENTS.

Compiled expressly for this journal by **Messrs. Page and Rowlingson, Engineering Patent Agents, 28, New Bridge Street, London, E.C.,** and at Manchester.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton Buildings, Chancery Lane, W.C., at the uniform price of 8d.

NEW PATENTS APPLIED FOR.

When Patents have been communicated the names of the communicators are printed in italics.

6. W. Cochrane, London. Jan. 2nd.—Improvements in and relating to the propulsion and manœuvring of boats and ships, including those of the submarine type.

19. H. S. Booth, Manchester. Jan. 2nd.—Improvements in motors.

26. R. H. Elkins, London. Jan. 2nd.—Improvements in lubricating machines.

30. J. M. Hewitt, Manchester. Jan. 2nd.—Improvements in pumps.

31. H. C. Braun, London. Jan. 2nd.—Improvements in liquid measuring machines.

41. C. W. Beissel, Hull. Jan. 2nd.—Improvements in oil separators.

50. P. Thielmann and J. Meisenburg, Germany. Jan. 2nd.—Apparatus for making frames for mine cages and the like.

55. J. Farnsworth, Notts. Jan. 2nd.—An improvement in paddle-wheel propeller for ships.

57. C. Barclay, Liverpool. Jan. 2nd.—Improvements in internal combustion engines.

61. T. Holland, Belfast. Jan. 2nd.—Double-rake automatic saw bench.

63. J. Mitchell, Cardiff. Jan. 2nd.—Improvements in or relating to double volute springs for wagon buffers and draw springs.

67. Fried. Krupp Akt.-Ges., London. Jan. 2nd.—Improvements in or connected with valve operating mechanism for motive power engines. (Date applied for April 16th. 1904.)

71. J. H. Broadwood, London. Jan. 2nd.—Improvements in and relating to couplings for railway and like vehicles.

78. S. A. Bhisey, London. Jan. 2nd.—New or improved levigating or pulping machine or apparatus.

93. J. B. Williams, London. Jan. 2nd.—Improvements in machines for bagging and weighing grain.

101. A. H. C. Gibson, Birmingham. Jan. 3rd —Apparatus and means for examining and gauging the conditions within the cylinders or other parts of mechanisms of any description, which mechanisms are concerned in the utilisation or development of pressure, or in the use of the expansive qualities of liquids or gases under pressure.

103. W. Dyer, Bournemouth. Jan. 3rd.—An improvement in couplings for railway trucks and the like.

108. A. Musker, Liverpool. Jan. 3rd.—Improvements in presses.

116. W. H. B. Maulkin, Keighley. Jan. 3rd.—Improvements appertaining to brake mechanism for railway vehicles.

123. W. L. Wise, London. Jan. 3rd.—Improvements in apparatus for, and process of electric welding and other metal working operations. (*The Thomson Electric Welding Company, U.S.A.*)

130. A. E. Tomkins, London. Jan. 3rd.—Improvements in and connected with clutches for conveying rotary motion.

141. K. Pohl, Germany. Jan. 3rd.—Improvements in rope, cord, and belt driving.

142. W. Hanke, Germany. Jan. 3rd.—Improvements in and relating to safety devices for machines with belt driving and disengaging gear.

146. O. Rost, Germany. Jan. 3rd.—A machine for automatically making screw taps.

147. J. Martin, London. Jan. 3rd.—Improvements in apparatus for coaling vessels,

149. W. H. Lomas, London. Jan. 3rd.—Improvements in apparatus for the separation of liquids from solids more especially intended for use in the treatment of metalliferous ores.

152. E. A. Richardson, London. Jan. 3rd.—Automatic block signalling system for railways. (Date applied for July 25th, 1904.)

166. J. M. Butler and B. Williams, Leeds. Jan. 4th.—Tidal power generator and elevator.

199. C. Hegans, London. Jan. 4th.—Improvements in or relating to locomotives.

200. T. L. Sturtevant and T. J. Sturtevant, London. Jan. 4th.—Power transmitting mechanism.

201. T. L. Sturtevant and T. J. Sturtevant, London. Jan, 4th.—Power transmitting mechanism.

216. G. W. Bell and F. M. Hale. London. Jan. 4th.—Improvements in torpedoes.

217. W. H. Wheatley, London. Jan. 4th.—Improvements in pneumatic tools. (*The Hudson Machine and Pnematic Tool Company, U.S.A.*)

227. B. E. Scriven and W. C. Smith, Manchester. Jan. 5th.—Improvements in mechanical variable transmission gear.

262. R. A. Hadfield, London. Jan 5th.—Improvements relating to projectiles with driving bands.

271. W. West, Birmingham. Jan. 6th.—Lock nuts applicable to bolts, screw pins, and the like.

289. W. T. Ellison, Manchester. Jan. 6th.—Improvements in and relating to superheaters.

293. T. F. Walker and T. S. Walker, London. Jan. 6th.—Improvements in and relating to ship's logs.

306. T. Carlyle, Ltd., and W. McLean, Birmingham. Jan. 6th.—An improved safety device for power presses.

307. The Westinghouse Brake Company, Ltd., and W. Rendell, London. Jan. 6th.—Improvements relating to fluid pressure brakes.

309. W. G Mein, London. Jan. 7.—Improvements in and relating to bearings.

325. R. A. Griffiths, Handsworth. Jan. 7th —Improvements in gas or oil engines.

340 A. Anderson, Dumbarton, Scotland. Jan. 7th.—Sensitive equalising valves for hydraulic pumping apparatus.

341. W. G. Heys, Manchester. Jan. 7th.—A new or improved thermostat. (*A. Goldstein, C. F. Patterson, R. L. McElroy, and J. E. Shepherd, U.S.A.*)

355. A. Harris and F. A. Anderson, London. Jan. 7th.—Improvements in and relating to surface condensors.

359. E. Allen and Co., Ltd., Sheffield. Jan. 7th.—Improvements in and relating to automatic coupling buffers for railway trucks and other vehicles. (*W. McIlwaine Robinson and E. E. Leichford, Transvaal*).

364. W. Lewis, London, Jan 7th.—Improvements relating to machine saws.

371. A. P. Filipi, London. Jan. 7th.—Improvements in propellers. (Date applied for Jan. 9th, 1904).

372. H. van Meerten, London. Jan 7th.—Improvements in or pertaining to turbines.

373. G. Bühler, London. Jan. 7th.—Improvements in pulley blocks. (Date applied for Jan: 9th, 1904.)

289. D. Hunter, Manchester. Jan. 9th.—Improved clinker pit in connection with boiler and other furnaces.

394. A. J. Howcroft, Uppermill. Jan. 9th.—Simple expansion locomotive engine with steam cut-off arrangement.

397. W. I. Twombly, London. Jan. 9th.—Improvements in process for forming steam.

419. Coln-Musener Bergwerks-Action Verein, London. Jan. 9th.—Improved method of avoiding of filling up blow-holes and like flaws in casting. (Date applied for Jan 11th, 1904.)

440. A. Latham, Birmingham. Jan. 10th.—Improvements in piston rings.

441. L. Delaney, Bradford. Jan. 10th.—Improvements in the setting or supports of stationary steam boilers for facilitating the inspection thereof.

442. A. J. Bailey, Manchester. Jan. 10th.—Improvements in valves for steam and other fluids.

454. J. Page, Reliance Engineering Company, Woodley. Jan. 10th.—Improvements in steam traps.

461. T. C. Philipson, Hull. Jan. 10th.—Improvements in scavenging, automobile gas, oil, and other explosive vapour engines.

463. B. S. Aslakson, London. Jan. 10th.—Improvements in apparatus for converting heat derived from fuel into energy, for utilisation.

467. J. K. Broadbent and S. T. Richardson, Manchester. Jan. 10th.—Improvements in and relating to the furnaces of steam generators and the like.

503. H. Techel and M. Salaschek, London. Jan. 10th.—Improvements relating to valve gear for internal combustion engines' (Date applied for Jan. 15th, 1905.)

507. A. W. French, London. Jan. 10th.—Improvements in valves for hydraulic presses.

511. H. Donner, London. Jan. 10th.—Improvements in or relating to engines or motors.

RECENT SPECIFICATIONS.

STEAM TURBINES.

The Hon. Charles A. Parsons, and G. G. Stoney, of Newcastle-on-Tyne. Dec. 30th, 1903.—Relates to improvements in the method of blading elastic fluid turbines, turbine pumps, and the like, described in Patents Nos. 10940 of 1891, 8697 of 1896, 8698 of 1896, 16284 of 1899, and 12347 of 1901, and has for its object to facilitate the manufacture of such apparatus, and to provide for the holding of the strip blades more securely and with greater accuracy of position. The invention consists in a method of manufacturing bladed root strips for steam turbines, comprising, (1) the cutting of transverse face grooves in the metal root strip; (2) the insertion of the blades into these grooves from the face; (3) the placing of the strip with its blades in a groove die adapted to retain the blades and strip in their relative positions; (4) the application of great lateral pressure so as to grip the blades in the strip and close up the air spaces, thus providing a blade carrying strip ready for attachment in any of the usual ways to the turbine drum or disc. The invention further consists in the construction of the blade rings by an improved method.

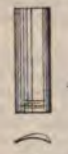


Fig. 1.

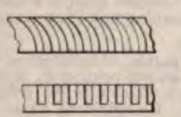


Fig. 2.

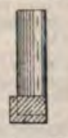


Fig. 2a

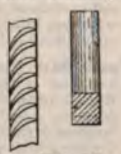


Fig. 3

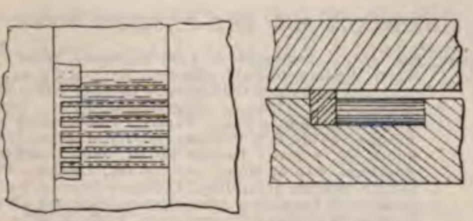


Fig. 4.

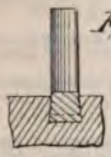


Fig. 5.

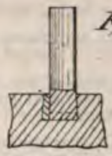
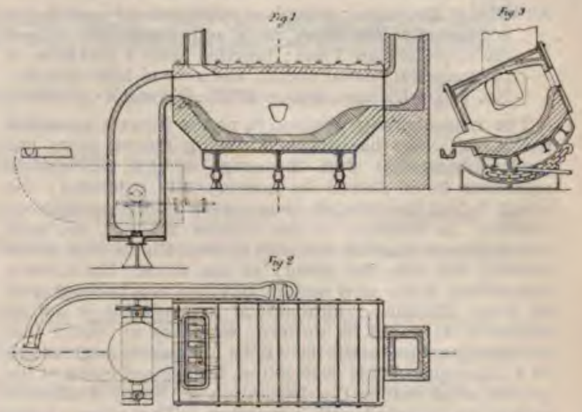


Fig. 6.

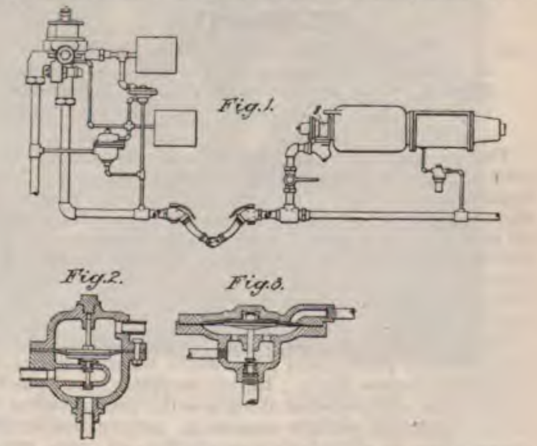
METALS AND ALLOYS.

Charles Cammell and Co., Ltd., J. E. Fletcher, and W. B. Hamilton, of Sheffield. Dec. 28th, 1903.—Refers particularly to the manufacture of steel. According to this invention the whole of the iron is melted in the heating furnace supplementing the waste heat from the converter by the combustion of some gas such as producer gas which is comparatively free from sulphur. By this means a continuous and rapid series of charges of steel of any grade is produced by first melting down iron in an open-hearth heating furnace. When this iron is molten, and if desired, slightly decarburised or otherwise refined, it is run directly into the converter and is there further decarburised as required by the well-known Bessemer, Robert, Tropenas, or other similar methods. The waste gases produced in the Bessemer converter are passed, in conjunction with producer gas and air, into the open-hearth heating furnace, thus producing sufficient heat to melt iron (and, if necessary, partially decarburise, desulphurise, or otherwise refine the same) rapidly enough to feed the converter after the completion of each charge of melt of steel.



LOCOMOTIVE BRAKES.

The Westinghouse Brake Company, Ltd., London (communication from the Westinghouse Air Brake Company, of Pittsburg, U.S.A). Jan. 19th, 1904.—Relates to fluid pressure brakes, and more particularly to devices for maintaining, in spite of leakage, the desired pressures in the train pipe and brake cylinders, respectively, of an automatic air-brake system while the brake remains applied. The objects of the invention are to provide improved means for supplying fluid under pressure to the train pipe while the brakes are applied, with the brake valve in lap position, whereby all leakage from the train pipe is compensated for and the pressure is maintained constant at the required degree of reduction for any length of time desired, and also having thus assured the maintenance of the desired pressure in the train pipe, to insure that the brake cylinder pressure shall also be maintained and any reduction therein, due to leakage, be automatically supplied from the train pipe. In this invention use is made of the well-known equalising principle as applied to the driver's brake valve for controlling the pressure of fluid in the regulating chamber of the apparatus. To maintain the brake cylinder pressure as mentioned above, despite leakage, a cylinder feed-valve device governed by brake cylinder pressure is employed for controlling communication between the train pipe and the brake cylinder. For maintaining a desired pressure in the train pipe, while the brakes remain applied, the pressure in a regulating chamber which controls the operation of the feed valve, governing communication between the main reservoir and the train pipe, is equalised with that to which the train pipe is reduced at the time of making the application of the brakes by means of an equalising device in the driver's brake valve.



NEW PUBLICATIONS.

"THE ROYAL NAVY LIST"

[illegible] a book of reference relating to the [illegible] officers of the Navy, both active and retired, and [illegible] the Fleet; together with a narrative of contemporary naval events, and a naval bibliography. No. [illegible] January, 1905. Witherby and Co. 10s.

The commanding position in public interest to which the Royal Navy has attained during recent years has made it essential that the scope of this well-known reference book should be considerably extended; the result is that the present issue makes quite a portentious volume. In addition to the regular features, we note that it is now possible not only to trace the careers of the officers, but also the history of the ships. Particularly interesting is the new section devoted to a bibliography of naval literature; although at present this is not so extensive as could be desired, we have no doubt that in subsequent issues the list will be judicicusly augmented; in a catalogue of this description, the titles of many of the papers read before the Institution of Naval Architects might be included with advantage. The cover of the volume is capable of improvement; a stronger binding would make the work more serviceable, and worthy of a permanent place in the reference library. Altogether, however, the editors are to be congratulated upon the comprehensiveness of their production.

"THE THEORY OF ELECTROLYTIC DISSOCIATION."

A Short Introduction, by J. C. Gregory, B. Sc., A.I.C. Longmans, Green and Co. 1s. 6d.

Students anxious to acquire a knowledge of the modern theory of electrolytic dissociation are recommended to secure a copy of Mr. Gregory's lucidly written treatise. The writer divides his subject into, the conditions of dissolved substances; ions and precipitation; the hydrogen and hydroxyl ions, and some electrolytic and general considerations.

"MAXWELL'S THEORY AND WIRELESS TELEGRAPHY."

Part I., "Maxwell's Theory and Hertzian Oscillations," by H. Poincaré; translated by Frederick K. Vreeland. Part II., "The Principles of Wireless Telegraphy," by Frederick K. Vreeland. Archibald Constable. 10s. 6d. net.

The author informs us that the aim of this work is to give a physical treatment of Maxwell's theory and its applications to some modern electrical problems, to demonstrate the fundamental principles which underlie all electrical phenomena, according to Maxwell and his followers, to show how these principles explain the ordinary facts of electricity and optics, and to derive from them a practical understanding of the essentials of wireless telegraphy.

Part I. deals successively with generalisations regarding electrical phenomena; Maxwell's theory; electrical oscillations before Hertz; Hertz's oscillator; methods of observation; propagation along a wire; measurement of wave-length and multiple resonance; propagation in air; propagation in dielectrics; production of very rapid oscillations; imitation of optical phenomena, and synthesis of light. Part II., for which Mr. Vreeland is responsible, opens with a discussion of the general principles of wireless telegraphy; this is followed by, telegraphy by Hertzian waves; the grounded oscillator; propagation of grounded waves; the receiving apparatus; and selective signalling. The work is profusely illustrated with useful diagrams.

NEW CATALOGUES.

Messrs. Everett, Edgcumbe and Co., of 151, and 152, Great Saffron Hill, Holborn Circus, E.C., have displayed considerable ingenuity in drawing attention to their electrical measuring instruments. Their folding card has an excellent representation of two hands enforcing the words, "It's just like this!" and contains the firm's offer to forward their price list.

A 1905 Edition of their illustrated catalogue of Iron Buildings, Roofs, Bridges, and General Constructional Work in Steel and Iron, has been issued by Messrs. Brownlie and Murray, Ltd., of Possil Iron Works, Glasgow. Most of the illustrations have been taken from work designed and erected by the firm, and they are intended to show the many uses for which iron and steel may be utilised with advantage in buildings of all descriptions.

Messrs. Mather and Platt, Ltd., of Salford Iron Works, Manchester, have issued a second edition of their catalogue of Polyphase Generators.

Messrs. Holden and Brooke, Ltd., forward leaflets giving extracts from letters of users of Brooke's 1903 Patent Steam Trap, and Patent "P.S." (Protected Seat) Valve.

"Stevedore" Plumbago laid Manila Rope, manufactured solely for transmission of power and hoisting cargo, is described and illustrated in a four page leaflet issued by the C. W. Hunt Company. We note that this rope is made four strand with a heart.

Matthews and Yates, Ltd., of Swinton, Manchester, have issued a pamphlet describing the "Cyclone" High Speed (Enclosed type) Forced Lubrication Engine. This engine is specially designed for driving fans and dynamos, and it is claimed that it is entirely self-contained, and is of the smallest possible dimensions compatible with ease in adjusting and cleaning, and the economical performance of the work it has to do.

From Mr. Eric S. A. Smith, of Bridlington, we have received a number of pamphlets and leaflets relating to Hydraulic Rams and Ram Pumps; "Climax" Steel Windmills for power and pumping purposes; Smith's American Incandescent Vapor Gas Lamps and Supplies; the "Handy Man" Oil Engine; the "Perfection" Direct Copying System"; the "Khoma" Gas Arc Lamp; and illustrations of high-fall single and double suction turbines, low fall turbines, etc.

MEETINGS FOR THE ENSUING WEEK.

FRIDAY, JAN. 27th. — Institution of Civil Engineers, Great George Street, Westminster, S.W. —Students Meeting, 8 p.m.: Paper, "Concrete-Making on the Admiralty Harbour Works, Dover," by Mr. T. L. Matthews.—Engineering Society: University College, London. 5 p.m.: Paper, "The Barrage of the Thames," by Mr. B. B. Willcox.—Royal Institution, Albemarle Street, W., 8 p.m.: Lecture by Dr. Wilson. — Electrical Engineers, Ball at Hotel Cecil, Strand, London.—Physical Society Meeting at the Royal College of Science, Exhibition Road, South Kensington, 5 p.m.: Papers, "Action of a Magnetic Field on the Discharge through a Gas," by Dr. Willows. "Action of Radium on the Electric Spark," by Dr. Willows and Mr. J. Peck. "The Slow Stretch in Indiarubber, Glass and Metal Wires when subjected to a Constant Pull," by Mr. P Phillips. "Determination of Young's Modulus for Glass," by Mr. C. A. Bell. "Some Methods for Studying the Viscosity of Solids," by Dr. Boris Weinberg.

SATURDAY, JAN. 28th.—Manchester Association of Engineers, Grand Hotel, 7 p.m.: "Multiple Effect Evaporation," Mr. Chas. Day

MONDAY, JAN. 30 —Society of Arts, 8 p.m.: Cantor Lecture, "Reservoir Fountain and Stylographic Pens," Lecture 2, by Mr. James P. Maginnis.

TUESDAY, JAN. 31.—University of Liverpool Engineering Society, 5.30 p.m.: Paper, "Electrical Transmission," by Mr. G. W. Worrall.—Institution of Electrical Engineers (Manchester Local Section), 8 p.m.: Paper, "Some Points in the Selection of Electric Cables," by Messrs. L. B. Atkinson and C. J. Beaver.

WEDNESDAY, FEB. 1.—Geological Society of London, 8 p.m.—Society of Arts, 8 p.m.: Ordinary Meeting.

THURSDAY, FEB. 2.—Chemical Society.—Civil and Mechanical Engineers' Society, Caxton Hall, Westminster, 8 p.m.: Paper, "The Mechanics of Flour Milling," by Mr A. R. Tattersall.—Royal Society Meeting, 4.30 p.m.—Royal Institution, 5 p.m

FRIDAY, FEB. 3.—Royal Society, 9 p.m.: Lecture by Professor T. Clifford Allbut.—Geologists' Association: Annual General Meeting, University College, Gower Street, 7.30 p.m.—Junior Institute of Engineers, Westminster Palace Hotel, 8 p.m.: Paper, "Recent Developments in Electric Lighting," by Professor H. T. Davidge.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

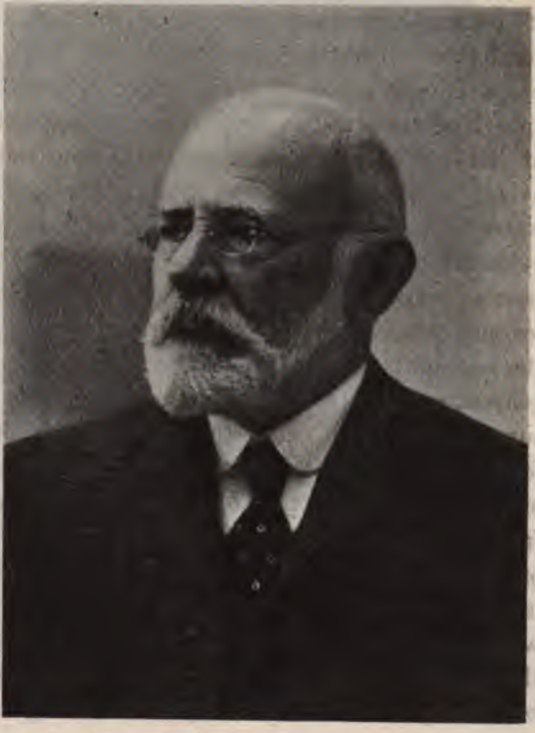
VOL. VI. LONDON, FRIDAY, FEBRUARY 3, 1905. No. 21.

The Offices of "Page's Weekly," Wednesday, Midnight.

IN pursuing the transference of heat from the fuel to the water in the boiler, it becomes necessary to consider the effect of heat upon water. The specific heat of water, or the quantity of heat required to raise its temperature, is greater than that of any other known substance. Consequently the specific heats of all other substances (water being taken as unity) are stated as decimal fractions. The specific heat of steel boiler-plate for example is 0·117, so that the quantity of heat which would raise the temperature of water one degree, would suffice to heat nearly 8½ times the weight of steel to the same extent.

From the temperature of melting ice up to the boiling point, or through a range of 180 deg. F., the absorption of heat by the water is regularly measurable by the thermometer; and disregarding the expansion of the water, practically a negligible quantity, we may say that to each pound of water 180 heat-units have been imparted. But to convert this pound of water, already at the boiling point, into steam at atmospheric pressure, requires 966 heat-units, or more than 5⅓ times the amount, and this without raising the temperature in the least. This considerable amount of mechanical work, or 966 × 772 = 745,752 foot-pounds, is only partly accounted for by the visible or external work performed, namely, the expansion of volume against the resistance of the atmosphere.

Steam at atmospheric pressure occupies a volume 1,646 times that of the water from which it was formed, or 26·37 cubic feet per pound. It has consequently displaced exactly



MR. CHARLES CONRAD SCHNEIDER.

President of the American Society of Civil Engineers.

According to the Engineering News of New York, to which we are indebted for the above photo, Mr. C. C. Schneider was born at Apolda, in the Duchy of Saxony, Germany, in the year 1843. In 1864 he graduated from the Royal School of Technology, at Chemnitz. He went to America in 1867, and for the last thirty years has been prominently identified with structural engineering in the United States.

that volume of air at a pressure of 14·7 lb. per square inch, or 2,117 lb. per square foot. This represents the external work amounting to 2,117 × 26·37 = 55,825 pounds lifted one foot high, leaving nearly 690,000 foot-pounds as the mechanical equivalent of the heat expended in overcoming molecular attraction. If we divide these two results by 772, the mechanical equivalent of heat, we find the external work amounts to 72·3 heat-units, and the internal or molecular work to 893·6, making up the well-known value of 966 heat-units, the British unit of evaporation.

In comparing the performances of steam-boilers, working at different pressures, and taking their feed-water at different temperatures, it becomes necessary to reduce the actual results to a common standard, in which the evaporation is assumed to take place at atmospheric pressure, and the feed-water to be supplied at 212 deg. F., generally known as "from and at 212." Supposing for the moment the feed-water to be supplied at 0 deg. F., we should evidently require 966 plus 212 = 1,178 units of heat to evaporate each pound of water, and so for any temperature of feed-water, say 65 deg., the heat-units required would be 1,178—65; or, generally, for evaporation at atmospheric pressure, 1,178—*t*; *t* being the temperature of feed-water. In most tables of the properties of saturated steam, the total heat is given as from 32 deg., reducing the figure 1,178 to 1,146, or, as more exactly stated, 1,146·6, which gives us the trouble of subtracting 32 in each case, when the temperature of the feed comes into the question. The total heat of steam increases but slowly in relation to the pressure, being at the rate of ·305 of a heat-unit for each degree Fahrenheit above 212 deg. On referring to a table we find the temperature of steam at 60 lb. pressure above the atmosphere to be 307·2 deg. Hence the total heat is 1·146.6 + ·305 (307—212) = 1,176. Double the pressure, and the total heat is only 1,146·6 + ·305 (350 — 212) = 1,189. Dividing these two results by the unit of evaporation, 966, we find the figures respectively to be 1·217 units, and 1·230 units. So that it costs little more to work at 120 lb. pressure than at 60 lb. Even at 160 lbs. pressure the heat supplied is only 1·236 units. These figures are significant in relation to the economy attending the use of steam at higher pressures.

To reduce the performance of a boiler working at 120 lb. pressure above the atmosphere supplied with feed-water at 60 deg. to the equivalent evaporation from and at 212 deg., the total heat of 120 lb. steam from the table of saturated steam is 1,189, and subtracting 32 deg. from the temperature of the feed-water, we have $\frac{1189-28}{966} = 1.2$; and this multiplied by the evaporative power of the boiler under the given conditions, say 9 lb. of water per lb. of coal, will give 9 × 1·2 = 10·8 lb. of water evaporated from and at 212 deg.

Feed-water heaters are employed to utilise the escaping heat of the exhaust steam. Taking an extreme case, that of raising the feed-water from the freezing to the boiling point, or through 180 deg., we have the ratio $\frac{1,146-180}{1,146} = \cdot843$ or 15·7 per cent. as the saving effected. This, of course, is out of the question. Taking more reasonable figures, say feed-water at 50 deg., and that this is heated up by the exhaust steam to 175 deg. Subtracting 32 deg. in each case, we have $\frac{1,146-143}{1,146-18} = \cdot888$, or 11·2 per cent. As the cost of an efficient feed-heater is by no means excessive, and the cost of maintenance resolves itself mainly into keeping the tube surfaces free from deposit, the saving effected, though not so large as sometimes professed, is, nevertheless, very well worth the outlay.

From the Journal of the Society of Arts.]

THE LATE SIR FREDERICK BRAMWELL, BART., D.C.L., F.R.S.

From the painting by Mr. Seymour Lucas, R.A., presented to the Society of Arts by Mr. Henry Graham Harris.

TABLE SHOWING THE OUTPUT OF COAL IN THE UNITED KINGDOM, ITS PIT'S MOUTH VALUE, THE QUANTITY SHIPPED FOR FOREIGN COUNTRIES IN THE FORM OF COAL, COKE, AND PATENT FUEL, THE TOTAL QUANTITY SHIPPED, INCLUDING COAL, SHIPPED FOR THE BUNKERS OF STEAMERS ENGAGED IN THE FOREIGN TRADE, THE QUANTITY REMAINING FOR HOME CONSUMPTION AND ITS PROPORTION TO EACH HEAD OF THE POPULATION FOR THE YEARS 1870 TO 1903.

Year.	(1.) Total Output.	(2.) Average Value per Ton at the Pit Mouth.§	(3.) Coal Exported.	(4.) Percentage of Total Output Exported as Coal	(5.) Coke Exported.	(6.) Coal Equivalent of Coke Exported.*	(7.) Patent Fuel Exported.	(8.) Coal contained in Patent Fuel Exported.†	(9.) Coal shipped for the bunkers of Steamers engaged in Foreign Trade.‡	(10.) Total Coal Shipped, Columns 3, 6, 8, and 9.	(11.) Percentage of Total Output Shipped.	(12.) Quantity remaining for Home Consumption for all purposes.	(13.) Population of the United Kingdom.	(14.) Quantity of Coal remaining for Home Consumption per head of the Population.
	Tons.	s. d.	Tons.		Tons.	Tons.	Tons.	Tons.	Tons.	Tons.		Tons.		Tons.
1870	110,431,192	—	11,177,976	10·12	326,296	543,826	198,377	178,539	No records	—	—	—	—	—
1871	117,352,028	—	12,208,009	10·40	341,865	569,775	198,115	178,303	"	—	—	—	—	—
1872	123,497,315	—	12,712,231	10·21	279,022	465,036	207,241	186,516	"	—	—	—	—	—
1873	128,680,131	—	12,077,507	9·38	261,649	436,082	278,410	250,569	3,312,470	16,076,628	12·49	112,603,503	32,177,550	3·499
1874	126,590,108	—	13,381,071	10·57	236,240	393,733	309,894	278,905	3,140,383	17,194,092	13·58	109,396,016	32,501,517	3·366
1875	133,306,485	—	13,978,956	10·48	307,629	512,715	258,331	232,497	3,278,249	18,002,417	13·50	115,304,068	32,838,758	3·511
1876	134,125,166	—	15,690,402	11·69	326,707	544,512	281,968	253,771	3,564,524	20,053,209	14·95	114,071,957	33,199,994	3·436
1877	134,179,968	—	14,880,899	11·09	333,640	556,067	205,511	184,960	3,661,552	19,283,478	14·37	114,896,490	33,575,941	3·422
1878	132,612,063	—	14,998,527	11·31	274,239	457,065	221,867	199,680	4,018,010	19,673,282	14·83	112,938,781	33,943,773	3·327
1879	133,720,393	—	15,740,082	11·77	345,438	575,730	356,776	321,098	4,401,120	21,038,030	15·73	112,682,363	34,302,557	3·285
1880	146,969,409	—	17,891,181	12·17	442,797	737,995	385,993	347,394	4,926,076	23,902,646	16·27	123,066,763	34,622,930	3·554
1881	154,184,300	—	18,759,991	12·16	414,762	691,270	412,310	371,079	5,227,588	25,049,928	16·18	129,134,372	34,934,476	3·696
1882	156,499,977	5 7·66	19,926,011	12·73	466,249	777,082	542,188	487,969	5,575,160	26,766,222	17·10	129,733,755	34,206,617	3·685
1883	163,737,327	5 7·50	21,670,926	13·23	488,001	813,335	616,707	555,036	6,400,594	29,439,891	17·90	134,297,436	35,449,721	3·788
1884	160,757,779	5 4·86	22,354,474	13·90	476,291	793,818	519,465	467,518	6,614,937	30,230,747	18·80	130,527,032	35,724,231	3·654
1885	159,351,418	5 1·96	22,710,335	14·25	548,375	913,958	512,247	461,022	6,681,359	30,766,674	19·30	128,584,744	36,015,601	3·570
1886	157,518,482	4 10·12	22,107,144	14·03	650,311	1,083,852	525,934	473,341	6,698,238	30,362,575	19·27	127,155,907	36,313,582	3·501
1887	162,119,812	4 9·87	23,258,855	14·34	661,931	1,103,218	540,181	486,163	6,868,790	31,717,026	19·56	130,402,786	36,599,143	3·563
1888	169,935,219	5 0·69	25,632,407	15·08	798,254	1,330,423	539,875	485,887	7,121,393	34,570,110	20·34	135,365,109	36,881,271	3·670
1889	176,916,724	6 4·21	27,504,911	15·54	769,480	1,282,467	682,054	613,849	7,736,794	37,138,021	20·99	139,778,703	37,178,929	3·760
1890	181,614,288	8 3·05	28,738,241	15·82	732,375	1,220,625	672,223	605,001	8,096,405	38,660,272	21·28	142,954,016	37,484,764	3·814
1891	185,479,126	7 11·88	29,496,785	15·03	859,543	1,432,572	727,788	655,009	8,536,495	40,120,861	21·63	145,358,265	37,796,390	3·846
1892	181,786,871	7 3·20	29,048,056	15·97	609,451	1,015,752	796,466	716,819	8,600,129	39,380,756	21·66	142,406,115	38,103,519	3·737
1893	164,325,795	6 9·51	27,708,128	16·86	602,774	1,004,623	721,053	648,947	8,126,372	37,488,070	22·81	126,837,725	38,434,629	3·300
1894	188,277,525	6 7·43	31,756,368	16·86	588,266	980,443	729,064	656,158	9,294,461	42,687,430	22·67	145,590,095	38,777,687	3·755
1895	189,661,362	6 0·42	31,714,906	16·72	700,064	1,166,773	686,482	617,834	9,407,789	42,907,302	22·64	146,754,060	39,113,465	3·752
1896	195,361,260	5 10·26	32,947,680	16·86	676,811	1,128,018	637,565	573,808	9,937,305	44,586,811	22·81	150,774,449	39,464,582	3·820
1897	202,129,931	5 10·93	35,354,256	17·49	978,327	1,630,545	764,295	687,865	10,455,758	48,128,464	23·81	154,001,467	39,825,357	3·867
1898	202,054,516	6 4·22	35,058,430	17·34	769,742	1,282,903	734,624	661,162	11,264,204	48,266,699	23·88	153,787,817	40,190,797	3·826
1899	220,094,781	7 7·03	41,180,332	18·71	867,295	1,445,492	1,063,777	957,399	12,226,801	55,810,024	25·35	164,284,757	40,555,623	4·051
1900	225,181,300	10 9·66	44,089,197	19·57	985,365	1,642,275	1,023,666	921,299	11,752,316	58,405,087	25·93	166,776,213	40,921,371	4·075
1901	219,046,945	9 4·29	41,877,081	19·11	807,671	1,346,118	1,081,160	973,044	13,586,833	57,783,076	26·37	161,263,869	41,544,145	3·882
1902	227,095,042	8 2·84	43,159,046	19·00	688,646	1,147,743	1,050,256	945,230	15,148,115	60,400,134	26·59	166,694,908	41,952,510	3·973
1903	230,334,469	7 7·93	44,950,057	19·51	717,477	1,195,795	955,166	859,649	16,799,848	63,805,000	27·70	166,529,469	42,373,800	3·930
Total	5,694,928,507	—	855,740,498	15·02	19,332,983	32,221,638	19,437,029	17,493,320	—	—	—	—	—	—

* The figures under column (6) have been computed on the assumption that for every 60 tons of coke exported, 100 tons of coal were consumed in its manufacture.

† The patent fuel exported has been assumed to contain 90 per cent. of coal; the remaining 10 per cent. consisting mainly of pitch.

‡ The figures given under this heading relate to the coal shipped on board British and Foreign passenger and cargo steamers bound for foreign ports.

FROM THE REPORT OF THE ROYAL COMMISSION ON COAL SUPPLIES. *(See page 256.)*

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

DAVIDGE PAGE, Editor.

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Alterations, &c., intended for insertion in the current week's issue must be delivered **not later than 4 p.m. on Monday.** If proofs are required the copy and blocks should reach us several days earlier.

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NEWS ITEMS.

In a coaling competition between the battleships *Victorious* and *Magnificent* at Devonport on Monday, the men in the *Victorious* took on board 1,500 tons in 12 6-17th hours, while the *Magnificent* was engaged for 17½ hours in performing the same task.

The *Sentinel*, one of the new scouts, during her official steam trials, maintained a speed during an eight-hour test of 25·249 knots, this being a quarter of a knot in excess of the guarantee given by the contractors, Messrs. Vickers, Sons and Maxim.

A proposal is on foot to provide Venice with new docks, which if carried out will be of the greatest importance to British coaling vessels. The proposed docks will have more than two and a half miles' frontage, the cost being estimated at £1,000,000.

It is stated that the Government have determined to take no steps for the creation of a ministry of commerce, and circulars are to be issued calling on the Associated Chambers of Commerce to bring all pressure to bear on the Government to reconsider the situation.

Replying to the toast "Our Guests," at the sixth annual dinner of the University College, Colston Society, Bristol, Sir Oliver Lodge, urged that the citizens should put forth their energies for the creation of a University College, because it would be a great educational centre of influence. With a University Bristol should be the educational capital of the west.

The Secretary of State for India has now sanctioned the proposals for financing the scheme adopted by the local government for the improvement of Madras harbour. The scheme provides for the closing of the present exposed harbour entrance, and the opening of another in the north-east wall of the harbour which will be protected by a breakwater about 1,200 ft. long. The cost of the scheme is estimated at £306,666.

The official abstract of the new German treaties of commerce has been completed. Under the heading of machinery the system of admitting certain important materials for ship building without duty is maintained, as in the case of ships' engines and boilers, but industrial machinery and mechanical tools are subjected to heavier duties. Motor carriages and bicycles will be charged for according to weight on a scale ranging from 15s. to £5 per 100 kilogrammes.

The 3,032 Carat Diamond.

The finding of a diamond weighing 3,032 carats on the Premier Mine has created quite a flutter in Hatton Garden. Even the most callous dealer in diamonds has never handled anything approaching the new diamond in size. As for the mining press it has been juggling with the intricate mysteries of troy weight, and some writers who have emerged from the ordeal limp and pallid, have given the result of their abstruse calculations. One is bound to say that there is not absolute agreement as to the weight of the new stone when translated from carats into mere ounces for while one writer modestly contents himself with the statement that the diamond weighs a shade over 1 ib., another mining statistician boldly asserts that the new Premier diamond weighs over a hundredweight. It will, perhaps, be interesting in view of this confusion of ideas to make a comparison between the new monster diamond and other famous gems.

South Africa produced a big diamond in 1893, when the "Excelsior," which weighed 970 carats, was found at Jagersfontein. The largest diamond up to the present time has been the famous "Braganza," now in the possession of Portugal, which in its uncut state weighed 1,680 carats. The "Braganza" is a Brazilian stone, but opinions differ as to whether it is a true diamond. The famous "Koh-i-nor" is an Indian stone, believed to have been found in the ground along the banks of the Kistna and Godaveri rivers, and the same source, claimed as the Golconda of tradition, is said to have yielded the "Regent" and the "Great Mogul."

The "Regent," one of the gems of the old French Crown, weighed in the rough state 410 carats. The

	Composition.	Specific Gravity.	Melting Point. Deg. Cent.	Spec. Res.	Temp. Co-ef. per Deg. Cent.
Aluminium Bronze	Cu. 90% Al. 10%	7·69	930	12·6	·00106
Brass	Cu. 65·8% Zn. 34·2%	8·39	1020	6·3	·00158
Chrome Steel	....	..	..	19·4	..
German Silver	Cu. 60% Zn. 25% Ni. 15%	8·5	1100	30	·00036
Manganin	Cu. 84% Mn. 12% Ni. 4%	8·9	..	46·7	..
Manganese Steel.. ..	....	7·8	1260	69	·00135
Manganese Copper ..	Cu. 70% Mn. 30%	..	..	101	·00004
Platinoid	....	8·8	..	41·7	·00082
Phosphor Bronze ..	Cu. Sn. P.	8·9	..	..	..
Silicon Bronze	Cu Sn. Si.	8·9	..	..	..
Tungsten Steel	....	..	..	22·5	..

	Approx. Mean Specific Gravity.	Melting Point. Roberts-Austen. Deg. Cent.	Specific Heat. Regnault.	Elongation % per Deg. Cent. Clark.	Spec. Res. Microhms per C.C. at 0° Cent.	Temp. Co-ef. per Deg. Cent.
Aluminium ..	2·67	625	·2122	·0022	2·56	·00423
Copper	8·853	1055	·0951	·0016	1·59	·00388
Gold	19·3	1045	·0324	·0014	2·2	·00377
Iron Wrought..	7·7	1600	·1138	·0012	9·07	·00625
do. Cast	7·218	1220	·1298	·001	..	..
Lead	11·38	326	·0314	·0028	20·4	·00411
Mercury	13·6	−40	·032	·01797*	94·3	·00072
Nickel..	8·81	1450	·1092	·00125	12·3	·0062
Platinum	21·51	1775	·0324	·00086	11	·0035
Silver	10·5	945	·057	·0019	1·47	·004
Tin	7·3	230	·0562	·0021	13·1	·0044
Zinc	7	415	·0956	·0025	5·75	·00406

* Cubic expansion.

THE PHYSICAL PROPERTIES OF METALS AND ALLOYS.

Messrs. Mather and Platt, Ltd., mechanical, electrical, hydraulic, and fire engineers, of Salford Iron Works, Manchester, have just issued a fifth edition of their valuable price list and pocket-book of tables and useful information. We reproduce the above tables dealing with the physical properties of metals and alloys.

"Great Mogul" was a prodigy in diamonds, the largest of which there is any authentic record in ancient history. Comparison with the "Premier" diamond is, however, impossible, as the "Mogul" disappeared in the sack of Delhi by Nadir Shah in 1739. Attempts have been made to identify the "Orloff" Russian stone as the "Great Mogul," but this is disputed by good authorities. The weight of the "Orloff" in its cut state is only 193 carats, and the "Mogul" must have been a far larger stone. Cutting, of course, reduces the weight of a stone to a considerable extent, and the larger the stone, the more the sacrifice in the cutting operations. A large stone is reduced by quite one-half, but even if two-thirds of the Premier stone were lost in cutting, it would still be by far the largest diamond in the world. The experts however, have yet to express their opinion on the stone, although it may be pointed out that other large diamonds recently found on the Premier mine have equalled in quality anything previously found in South Africa, cutting well and possessing great brilliancy.

The Premier Mine, where the big diamond has been discovered, is, as mining men are aware, in the Transvaal, and not on the Kimberley Field, and the discovery has naturally caused a sensation at Johannesburg, where the diamond has been exhibited prior to its shipment to London. It is said to measure 4½ in. by 2¼ in. The South African diamonds, as is well known, differ in appearance from those of India and Brazil, being bright without incrustation, and any imperfection being generally visible in the natural state.

The Iron and Steel Institute.

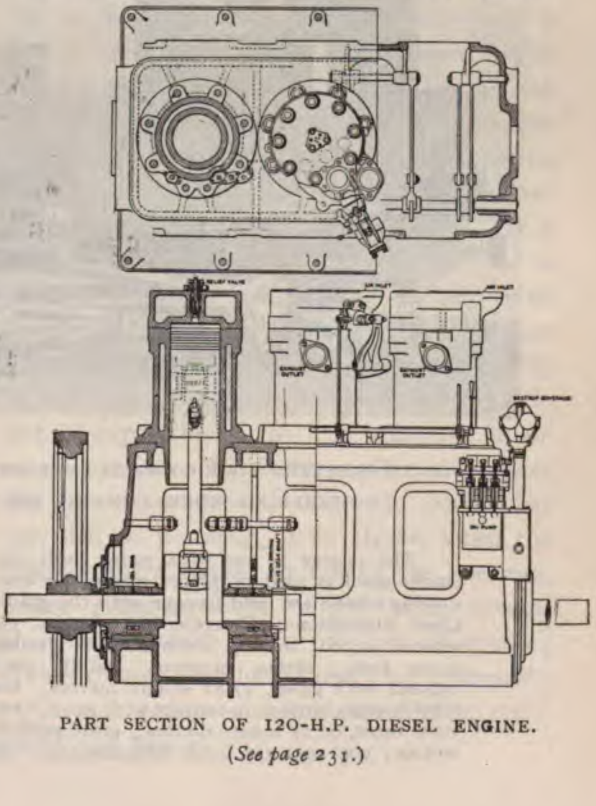
The annual general meeting of the Iron and Steel Institute will be held, by permission, at the Institution of Civil Engineers on Thursday and Friday, May 11th and 12th, 1905. The annual dinner will be held—under the presidency of Mr. R. A. Hadfield—in the Grand Hall of the Hotel Cecil, on Friday, May 12th. The council will shortly proceed to award Carnegie Research Scholarships, and candidates must apply before February 28th. The awards will be announced at the general meeting.

The autumn meeting as already stated will be held in Sheffield on September 25th to 29th, 1905.

Members are invited to participate in the International Congress of Mining, Metallurgy, Mechanics and Applied Geology, to be held at Liége on June 26th to July 1st, 1905, in connection with the International Exhibition. The general secretary of the organising committee is Mr. Henri Dechamps, 16, Quai de l'Université, Liége, and the committee comprises Mr. Jules Magery, Member of the Iron and Steel Institute, president; Professor Alfred Habets, vice-president, president of the mining section; Mr. Adolphe Greiner, Member of the Council of the Iron and Steel Institute, president of the metallurgical section; Professor Herman Hubert, president of the mechanical section, and Professor Max Lohest, president of the section of Applied Geology. The subjects to be dealt with in the metallurgical section comprise coke manufacture; blast furnace practice; influence of titanium, arsenic and other substances on iron and steel; removal of dust from blast-furnace gas; slag cement; use of poor gas as motive power in rolling-mills; new methods of open-hearth steel manufacture; alloys of steel with chromium, nickel, manganese, vanadium and tungsten; the forging press and steam hammer; electro-metallurgy and the practical applications of metallography. Visits to the Exhibition and to scientific and industrial establishments will be arranged. Further particulars may be obtained on application to Mr. Bennett H. Brough, secretary.

The Diesel Engine.

Concerning the Diesel engine (which is the subject of an article in this issue), Messrs. The Mirrlees Watson Company, Ltd., of Glasgow, write: From seven to eight years ago we made the first Diesel engine constructed in Great Britain. This engine showed that there were certain difficulties to be overcome

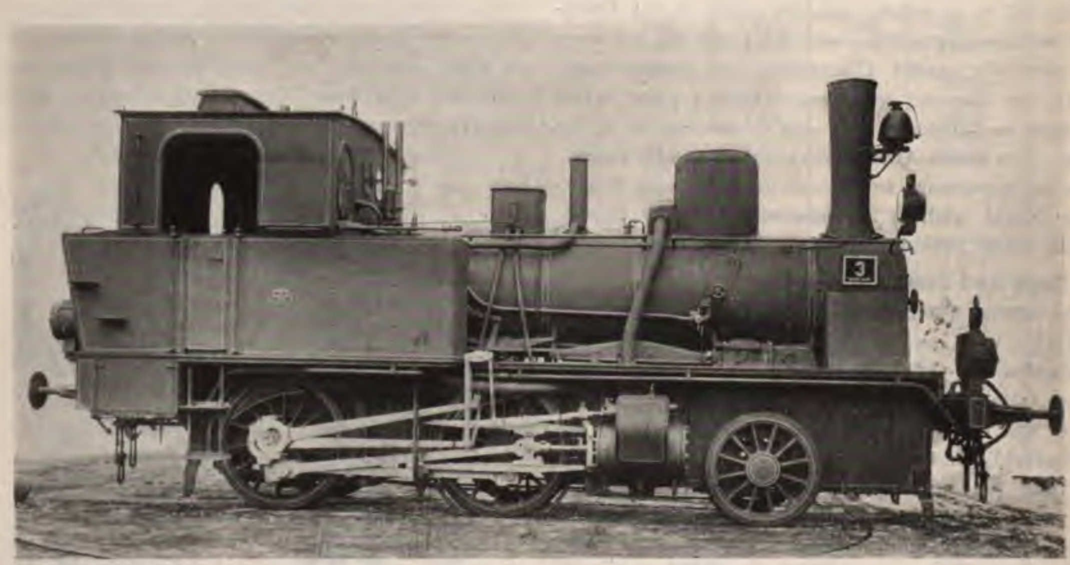


PART SECTION OF 120-H.P. DIESEL ENGINE.
(*See page* 231.)

before the engine was suitable for general use. During the intervening years we have carried out many experiments and trials, but the past year has seen the development into a completely satisfactory form of this engine. The early troubles of choking of passages and oil sprayers have been quite eliminated; and we have now had three engines in operation in our own works for 21, 12, and 9 months respectively, and have thoroughly satisfied ourselves that the earlier troubles have been completely eliminated.

Simplex Conduits.

The Publicity Department of the Simplex Steel Conduit Company have earned the gratitude of wiremen by issuing a very handy and complete booklet, entitled "Simplex Conduit Erection and Wiring," by Mr. L. M. Waterhouse, M.I.E.E., A.M.Inst.C.E. The volume is well illustrated and is handsomely bound. It is admirably adapted for pocket use. A succinct preface sets forth that although steel conduits have become almost universal in present day practice, and are admittedly recognised as the best protection for interior circuits, the subject of conduit wiring has been generally neglected in current technical literature, and it is almost impossible to refer to any work dealing exclusively with this subject. The author's object, therefore, has been to give practical and detailed information concerning the various parts of the Simplex system and their application in practice. The best arrangement and design of circuits, and particulars of up-to-date installation methods have also been included, in order to assist the observant wireman to an intelligent knowledge of how best to meet the varying requirements of conduit installation work, as well as to lead him to an appreciation of the capabilities of the system to carry out each and all of those requirements efficiently and economically. We have also received the firm's "Simplex" price list for 1905, uniformly bound, together with leaflet No. 102 showing important percentage reductions.



TYPE OF SIX-WHEELED FOUR-COUPLED PASSENGER TANK LOCOMOTIVE BUILT BY THE HUMBOLT ENGINEERING WORKS COMPANY FOR TRAFFIC ON THE MOSELLE RAILWAY.

The engine is one of a series built for slow passenger traffic. The steam bell on smoke-stack is used in places where the line runs through unprotected places. The small driving wheels are used to cope with the gradients which in the hilly districts are considerable. Chief dimensions: Diameter of cylinders, 350 mm.; stroke, 550 mm.; diameter of driving wheels, 1,300 mm.; diameter of trailing wheels, 1,050 mm.; total wheel base, 4,500 mm.; steam pressure, 200 lb. per square inch; heating surface of tubes in contact with gases, 57·81 square metres; heating surface of fire-box, 4·87 square metres; total heating surface in contact with gases, 62·68 square metres; total heating surface in contact with water, 69·27 square metres; grate surface, 1,285 square metres; tank capacity, 5·5 cubic metres; coal capacity, 1,600 kilogrammes; weight, light, 26¾ tons; running weight, 36 tons.

THE DIESEL ENGINE IN PRACTICE.

BY JAMES D. MACPHERSON.

Apart from its general reliability the Diesel engine is of interest to manufacturers and engineers owing to the fact that it consumes cheap grade oils, rendering it a suitable motor for driving shop machinery, cranes, lifts, pumps, dynamos, etc. Several of the accompanying illustrations have been lent by the Mirlees Watson Co., Ltd., of Glasgow, who specialise on this form of oil-engine.—ED.

THE Diesel engine operates on what is commonly known as the Otto or four-stroke cycle; that is to say, the cycle of operations in one cylinder is completed in four strokes, as follows :—

First : Downward (or outward, if horizontal) aspiration stroke. In this stroke the piston moves to the outward or bottom end of the cylinder, and at the same time, either by suction or mechanically, the air admission valve opens and allows the cylinder to fill with fresh air at atmospheric pressure. The air issome what heated in passage through the valves and port, hence, when the end of the stroke is completed, it is somewhat below atmospheric density and a little higher in temperature, but this difference has little effect on the results obtained.

Secondly : Upward (or inward) stroke compression. During this stroke, the air is compressed to a pressure of 500 lb. per square inch, at which pressure it has sufficient temperature to ignite any form of petroleum (crude or refined) spontaneously. There are no valves open during this stroke, and there is nothing in the cylinder but pure air. The volume of compression space is all embodied in the cylinder head and is first found by calculation. A wooden pattern is then made and whittled until its weight agrees with the calculated volume. Then a plaster-of-Paris core box is made, and this is used to make the cores for all similar heads.

Thirdly : When the piston has reached the top of the compression stroke and the crank is just crossing the dead centre there is the opening of a small needle valve, called the fuel valve (placed on side of cylinder at one end of the port, in which the other valve opens), and a mixture of fuel and compressed air is blown into the cylinder. The quantity of fuel is not all blown in at once ; instead, the fuel injection is maintained for a period equal to 10 per cent. of the downward stroke of the piston. It is possible to do this with the small quantity of petroleum necessary, by reason of the mixture with compressed air, which increases the volume and thus gives a quantity whose injection can be controlled. The compressed air referred to is compressed by an independent two-stage compressor to 800 lb. per square inch, and cooled before introduction to the food valve. During this period the intention is to maintain the temperature in the cylinder nearly constant, allowing the pressure to fall in conformity with the laws of expansion at constant temperature. It is apparent that this can only be attained at or near the normal load of the engine. With an overload the temperature will rise somewhat, and with a light load it must fall, as the quantity of fuel injected is not sufficient to add the heat lost in expansion of the large quantity of air in the cylinder. After the needle valve closes the hot gases expand until the piston has travelled 90 per cent. of its stroke, when the exhaust valve opens, to relieve the pressure, before commencement of the next upward or exhaust stroke. The pressure at opening of the exhaust valve for normal load is generally 35 lb. per square inch and the temperature about 700 deg. F.

Fourthly: This fourth and last stroke of the cycle takes place with the piston travelling upward; the exhaust valve opens, and the hot gases rush out through the valve and port. When the piston reaches the top centre the exhaust valve closes, the admission valve begins to open, and the whole series of operations is repeated.

SINGLE-CRANK, SINGLE-CYLINDER TYPE.

In the natural order of things a single-cylinder engine was first built, and its construction and use is continued for all power-driving, purposes except electric lighting where the uneven impulse, on the crank, affects the light, unless an extremely heavy flywheel is used. Fig. 3 shows the crank effort on a 16 by 24 single-cylinder engine. Fig. 4 shows the crank effort, velocity curve, and displacement of the crank-pin on a 12 by 18 triple-cylinder engine. Fig. 5 shows the same curves for 16 by 24 six-cylinder engine.

With the single-cylinder engine the standard flywheels furnished for ordinary factory work would be used. With the three-cylinder engine, in fig. 4, a somewhat heavier flywheel was used to drive 60-cycle inductor machines on electric lighting, while with the six-cylinder engine a very heavy wheel was used, as the work was that of a suburban trolley line.

DOUBLE-CRANK ENGINES.

When a four-cycle engine is made of the double-cylinder type with two cranks, the customary method is to have the cranks run together, or 360 deg. apart, causing the shaft to receive an impulse every revolution first one cylinder and then the other receiving an ignition. This type runs very well, but for manufacturing and other reasons, another cylinder is added, and the three-cylinder engine is more nearly the accepted standard, while with the constantly increasing demand for larger engines, the four-cylinder unit must be reached, and at at present, to meet requirements for a 500 h.p. unit, two three-cylinder 250-h.p. engines are coupled direct to 300 kw. alternating current generator between them.

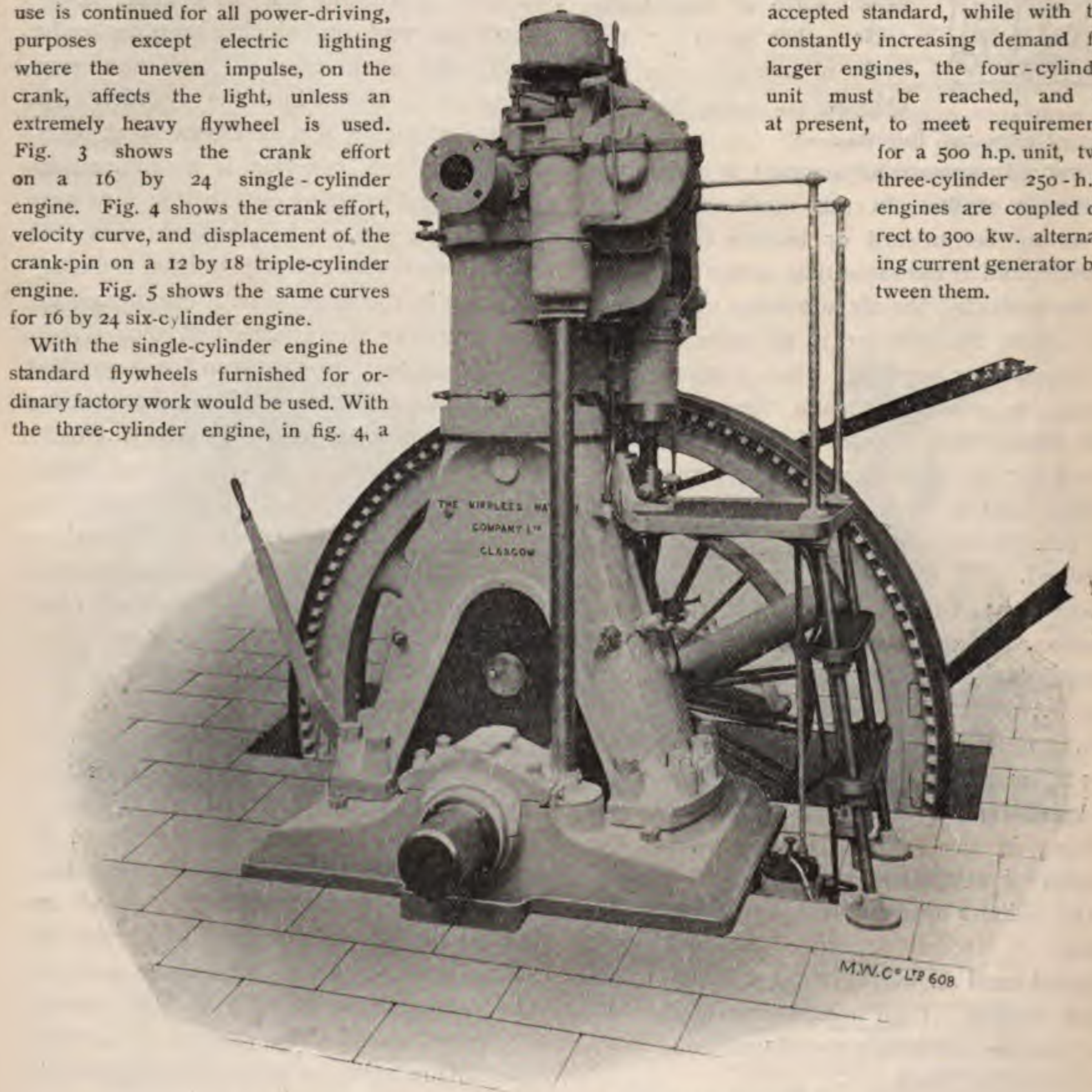


FIG. I. SINGLE CYLINDER 35 B.H.P. DIESEL ENGINE,
As installed at the Scotland Street Works of the Mirrlees Watson Company, Ltd., Glasgow.

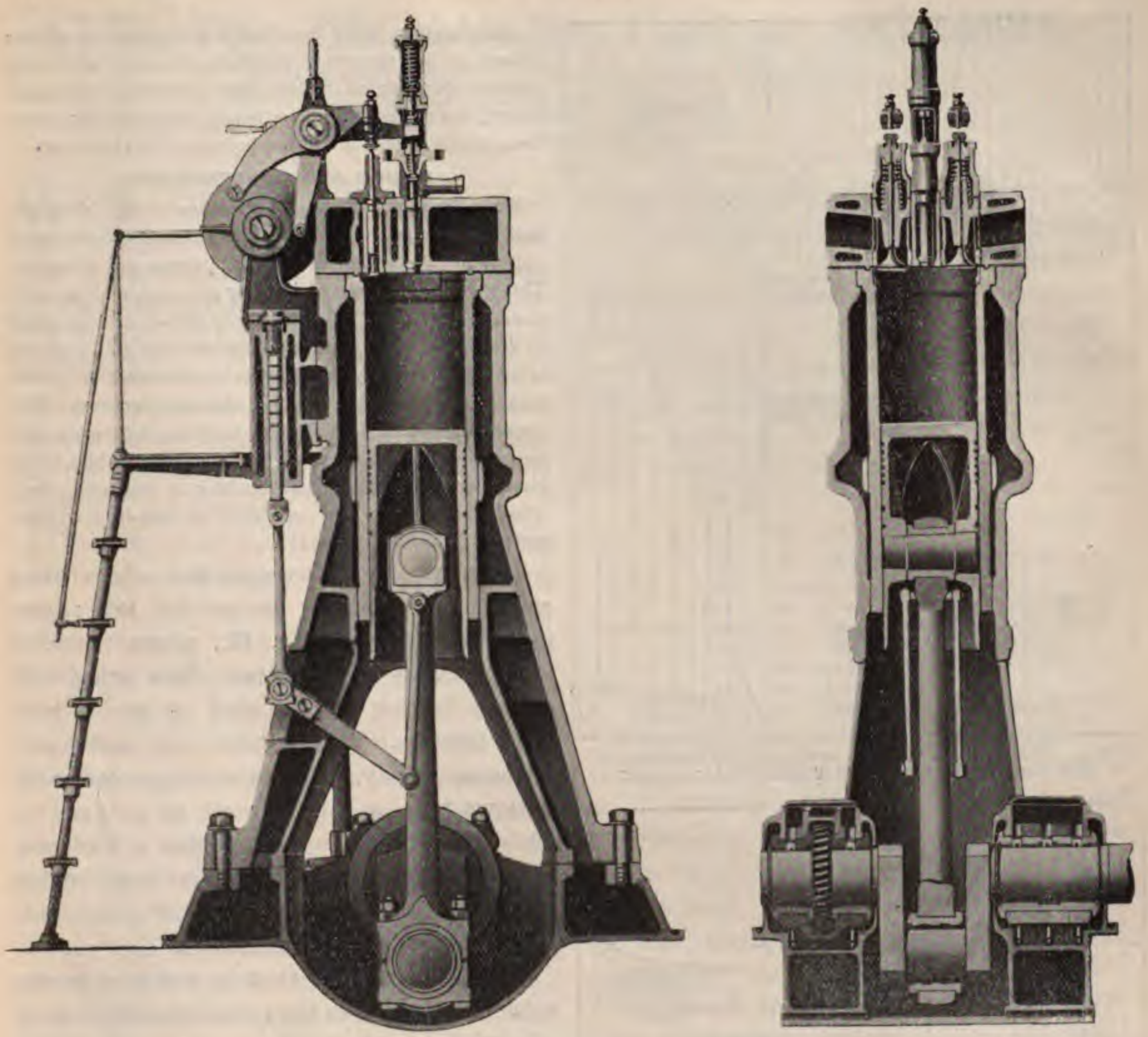


FIG. 2. SECTIONAL ARRANGEMENT OF THE DIESEL ENGINE.

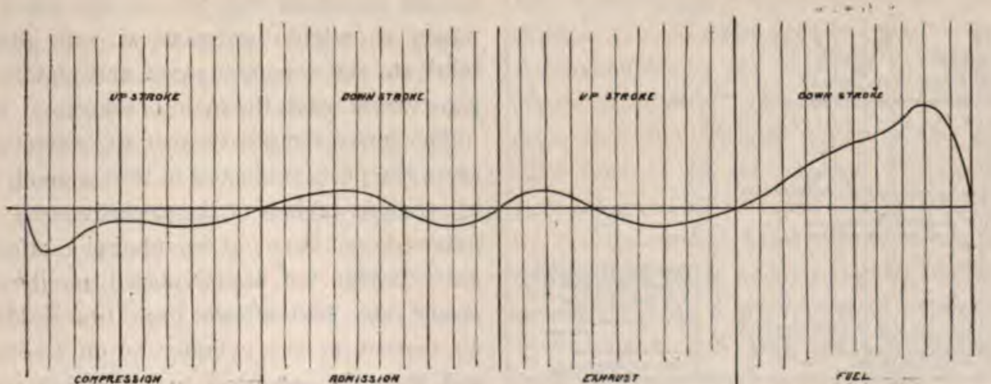


FIG. 3. SHOWING CRANK EFFORT ON A 16 BY 24 SINGLE-CYLINDER ENGINE.

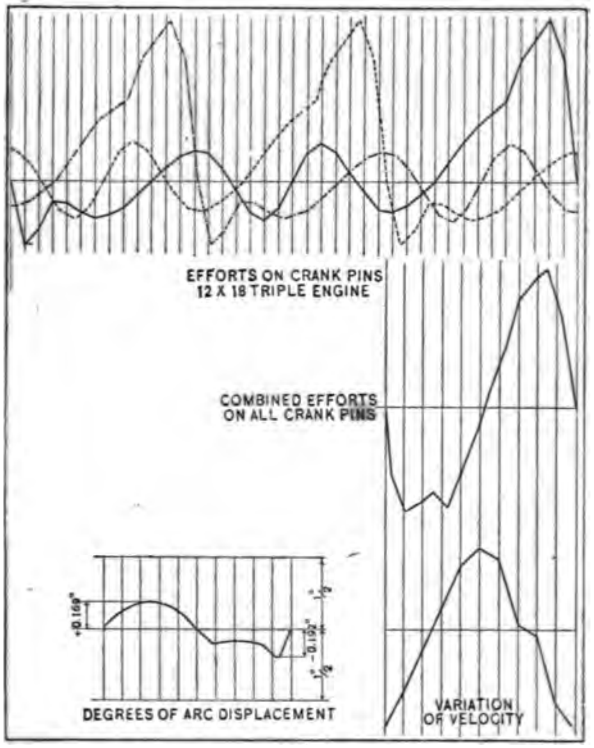


Fig. 4. Crank effort, velocity, curve, and displacement of the crank pin on a 12 by 18 triple cylinder engine.

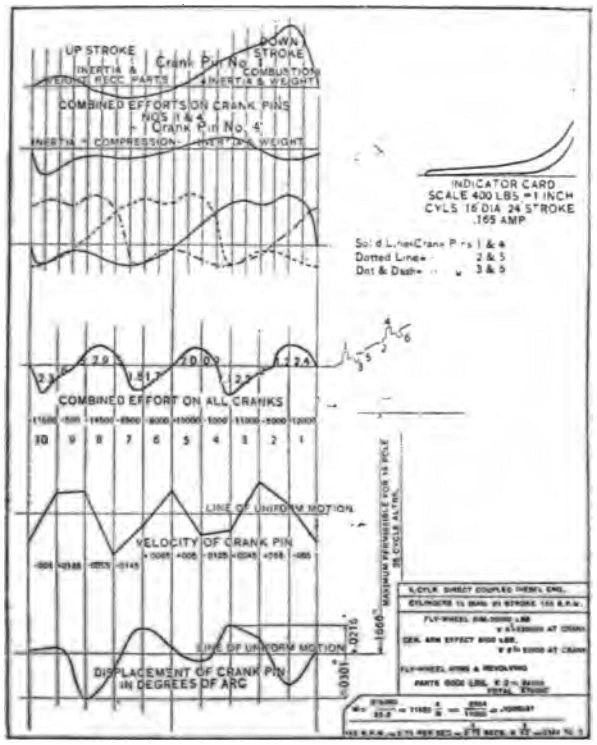


Fig. 5. Curves for a 16 by 24 six-cylinder engine.

Small engines have been built to operate on what is known as the two-cycle principle of operation, while engines operating on the four-cycle principle, but double-acting, are projected. These being aside from the direct issue of this article, it will not be treated of at present.

DESIGN AND CONSTRUCTION.

From the section through the centre of the cylinder it will be seen that the piston is a long trunk proportioned approximately with the length, 2½ times the diameter. This gives a minimum of bearing pressure, and wear is almost eliminated. There are four cast-iron rings fitted in grooves at the top end, and the top end of the piston is tapered at least $\frac{1}{32}$-inch smaller in diameter, so as not to seize when expanded by the high temperature. The connecting-rods are solid steel forgings, the boxes also being of steel, machined out and lined with babbit at the lower end, and with a brass bushing at the upper end. The main bearings are supported on cast-iron wedges and also adjustable sideways.

There are numerous examples where these engines are operating on variable load; one in particular at Peoria, Ill., where the load is supplied by two elevators, there being only enough lighting current used to give a load of 5 amperes. The elevators are used intermittently all day, so that the load is constantly varying from a half kilowatt to 40 and 50, while the voltage is kept within a variation of 4 volts, the generator is over-compounded and assists in this result, but even with this load the results are remarkable.

It will be noticed that in addition to the splash lubrication in the crank case, there is an oil chamber and an oil ring provided in the main bearings. This is a safeguard against the oil becoming too low in the crank case, where it might be splashed sufficiently to lubricate the connecting rod and piston, while none would reach the main bearings.

The lower temperature of the Diesel engine gives the parts subjected to heat a much longer life than in engines of the explosive type. The valves do not burn out, no admission or exhaust valve having yet been replaced, nor have any shown any bad effects from heat. There is no deposit in the cylinder or on the valves, and they do not need to be withdrawn for examination.

From a paper contributed to the Engineers' Club of Philadelphia.

STEEL FOR THE MANUFACTURE OF ARTILLERY.

By COLONEL CUBILLO (SPANISH ROYAL ARTILLERY).

V.—WATERVLIET ARSENAL.

(*Continued from page* 180.)

WATERVLIET ARSENAL, situated in West Troy, near Albany, N.Y., was decided upon by the Mixed Committee as the workshop for the manufacture of artillery for the army. It is in touch with three or four railway lines, the Hudson river, the Erie canal, and New York. Four hours' journey by rail and eight by water offer all the advantages of a city of importance for the acquisition of materials, recruiting of workmen, and despatch of goods abroad.

The gun shop has three bays, the central one being much higher than the two lateral bays. In the central bay are the boring, rifling, turning and chambering machines. The lathes, boring and rifling machines have been supplied by the Niles-Bement Pond Company. The same care is exercised at Watervliet as at Washington for the prevention of accidents.

The Arsenal has a tool room, which forms part of the large artillery workshop, where the special tools are manufactured and repaired. This room is very completely equipped with gauges, tools, and measuring instruments of precision, supplied by the Pratt and Whitney Co.

There is another shop, devoted to the 5-in. pieces field guns, where, at the time of our visit, the 75-millimetres Vickers-Maxim model mountain guns, 9-centimetre field howitzers, siege guns of 127 millimetres, 177·8-millimetre howitzers, and rapid-fire guns of 127 millimetres were made.

Last year the coast-gun factory turned out twenty-nine pieces of the 1897 model 150-millimetre guns, and had in hand forty-six of the same calibre, model 1900. Twelve guns of 25 centimetres, model 1895, were being constructed, and the tubes and sleeves for six others of the 1900 model had been received.

An experimental 25 - centimetre howitzer had been finished and sent to the Sandy Hook grounds for testing. During the year the arsenal had completed of the model 1895 30·5 - centimetre guns eleven and had eighteen in hand. Of the 1900 model the experimental gun had been finished and eleven were being completed. Lastly, of the forty, 1890 model, howitzers of this calibre twenty-nine were finished with the exception of the firing mechanism.

The details of the model 1897 and 1900 guns, made for the army, are as follows :—

	Calibre.	Length.	Weight of Projectile.	Initial Velocity.	Perforation.	Remarks.
	c/m.	Calibre.	Kg.	Metre.	c/m.	
Model 1897	15	45	45	793	23	Krupp plates and tipped Projectile.
	25	35	260	701	42·9	
	30·5	35	453	701	59·9	
Model 1900	15	50	45	915	28	
	25	40	260	780	50	
	30·5	40	453	780	62·9	

Watervliet has a system of manufacture similar to all artillery factories. That in vogue at present is composed of a central tube, and the necessary sleeves and hoops. They have adopted as the elastic limit for their calculations the minimum admitted for the reception of the steel, taking into account the deformation produced by the elastic strain.

In pieces of 20, 25 and 30 centimetres a minimum tangential resistance of 3,700 kilogrammes per square centimetre is obtained in the chamber, and the average normal pressure of these guns does not exceed 2,600 to 2,700, or, approximately 73 per cent. of the tangential elastic resistance. The American officials estimate that the highest pressure the guns I have referred to are capable of resisting is 4,916 kilogrammes per square centimetre, judging by experiments at Sandy Hook, where a gun of this class burst under a slightly higher pressure when using a too powerful explosive. A 15-centimetre gun will resist a pressure of 6,040 kilogrammes per square centimetre without worse damage than the wedging of the lock.

(*To be continued.*)

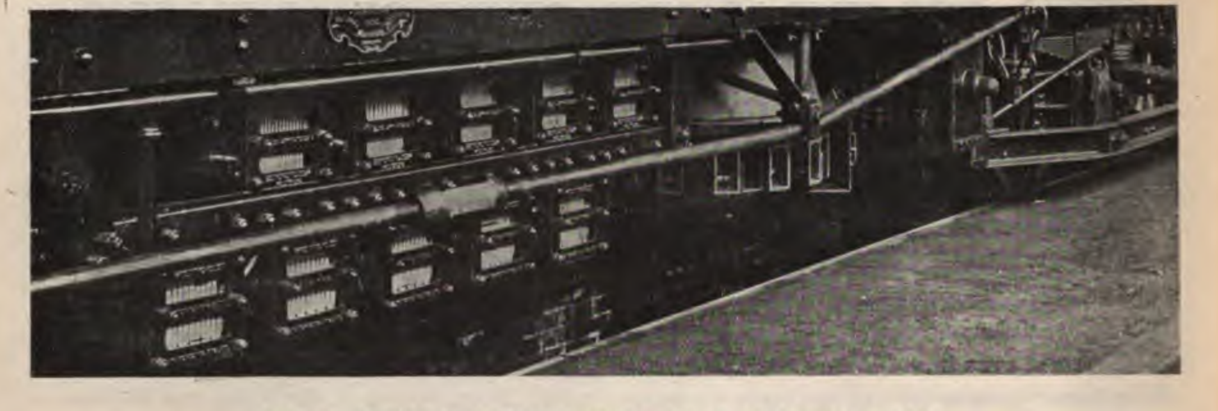


FIG. 1. SHOWING TURRET CONTROLLER IN POSITION ON CAR.

The Electrification of the Metropolitan Railway.

(*Continued from page* 189.)

ALL the electric trains on the Metropolitan Railway will be operated on the multiple unit system. The Westinghouse unit switch system of control consists essentially of two parts, the turret controller carried under the body of the motor-car, and the master controller placed in the motor-man's cab. The former takes its name from its shape, and is a wonderfully ingenious combination of magnetic blow-out switches and pneumatic cylinders controlling them. Grouped around the centre are 15 unit switches or circuit breakers, each of which is operated by a separate pneumatic cylinder, working against a powerful spring. The latter tends to open the switch, which can only remain closed so long as the air pressure is in the cylinder. The magnetic blow-out arrangement consists only of one coil that affects all the switches alike. It is marked B in fig. 2, and fig. 3 shows its trough-shaped pole-pieces, which point alternately up and down, the former being fixed to the main casting and the latter to a special spider, or extension of the magnet core, at the bottom. The switch contacts are each surrounded by a vulcabeston box open at the front, and are placed in the direct path of the magnetic field, as shown in fig. 3. The *raison d'etre* of this single blow-out coil is that it makes it possible to obtain a much stronger field with less wiring and weight of material than with the arrangement of small separate coils.

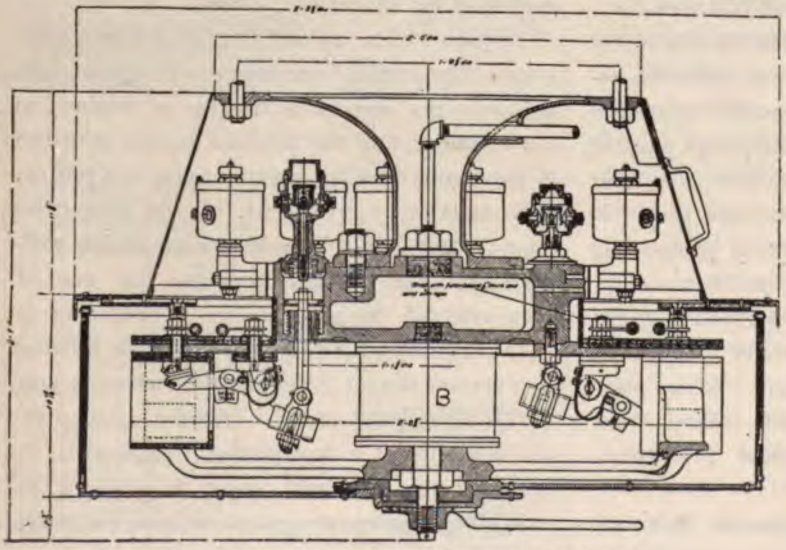


FIG. 2. SECTION OF TURRET CONTROLLER.

The air cylinders, placed in a circle above the switches, are controlled by magnetically-operated needle valves, which, when open, allow compressed air to pass from the central chamber where it is stored to the cylinder closing the switch attached to it. The pipe projecting from the centre of the turret controller (figs. 2 and 3), conveys compressed air to the storage space.

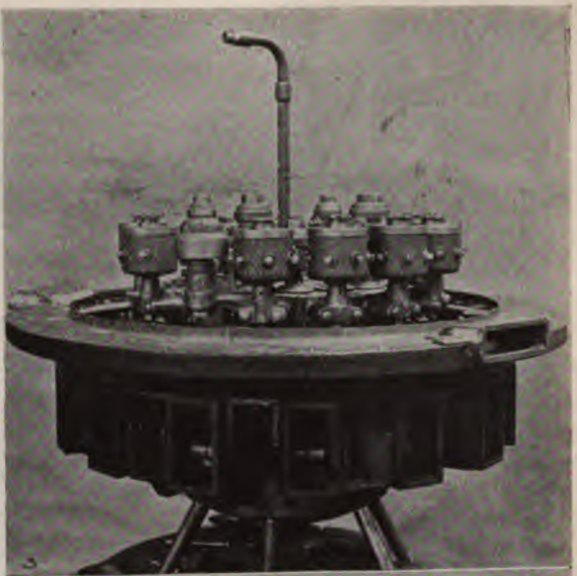
The master controller shown open in fig. 4 and in position in fig. 5 is remarkable for its small size and compactness. It operates the above-mentioned needle air valves of the turret controller by aid of a 14-volt current taken from a small storage battery of the car. As will be seen it has five notches for both forward and backward running in addition to the "off" or neutral point. The movement of the controller handle to the first step sets the emergency brake valve; the second sets the reverser—a piece of apparatus for controlling the direction in which the car is run—and puts on the main supply current; the third or shunting notch connects the motors in series with all resistance in; the fourth brings the automatic accelerator into play which closes the switches of the turret controller in their right order, unless checked by what is termed the limit switch; and the fifth opening all the pneumatic switches that have been closed and simultaneously throwing in others connects the motors in the first parallel stage with resistance in circuit.

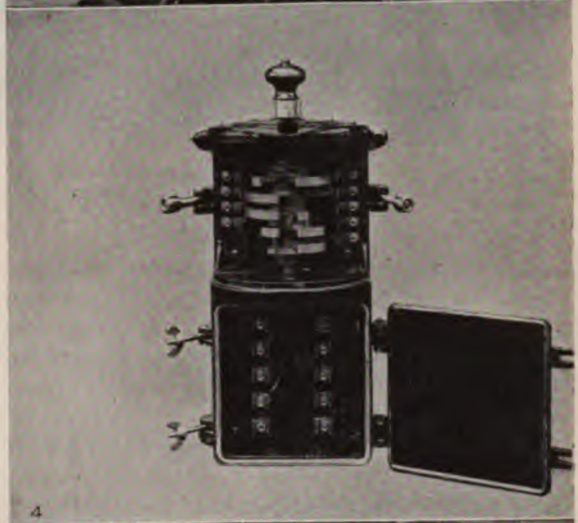
To make the matter clear some further description of the auxiliary apparatus mentioned above is necessary. The reverser, shown in fig. 6, is pneumatically operated and upon it as stated depends the direction in which the car runs. The movement of the controller to the second notch magnetically actuates its valves shown on the right of the figure, and admits air to the cylinders that move the switch. The limit switch accelerator, which is a very important part of the apparatus, commences operation at the fourth step and automatically closes the turret controller switches one after the other up to the eighth resistance or last series point.

After the movement of the master controller to the fifth notch has effected the change from series to parallel the automatic accelerator again comes into play, and limits the rate at which the necessary changes in connections are made to attain full speed.

The overload and no voltage relay shown in fig. 7, is in electrical connection with the actuating magnet of one of the pneumatic cylinders of the turret controller, which operates the main circuit breaker. To prevent damage from a resumption of supply, after any interruption, such as a break in the third rail, or persistent bad contact in the collecting shoes, the no voltage part of this device returns the controller to a position in which some considerable amount of resistance is in circuit, allowing it to be gradually and automatically cut out when the current comes on again. Sudden interruptions and resumption of supply such as occur when the collectors pass over points or crossings do not affect the relay, it being arranged to work too slowly for this.

Three of the most important points in the control equipment of these cars that are ingenious, and have been found to be useful, are as follows: The possibility





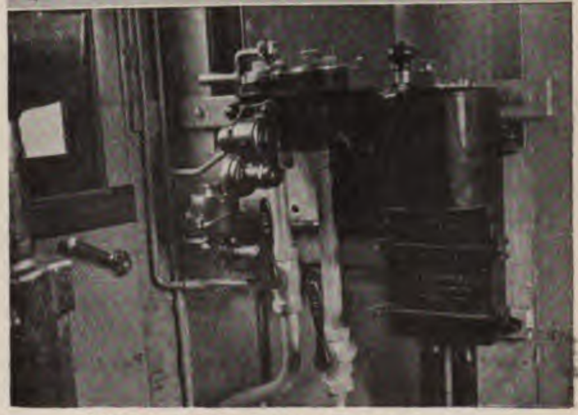


FIG. 3. TURRET CONTROLLER.
FIG. 4. MASTER CONTROLLER.
FIG. 5. MASTER CONTROLLER IN POSITION.

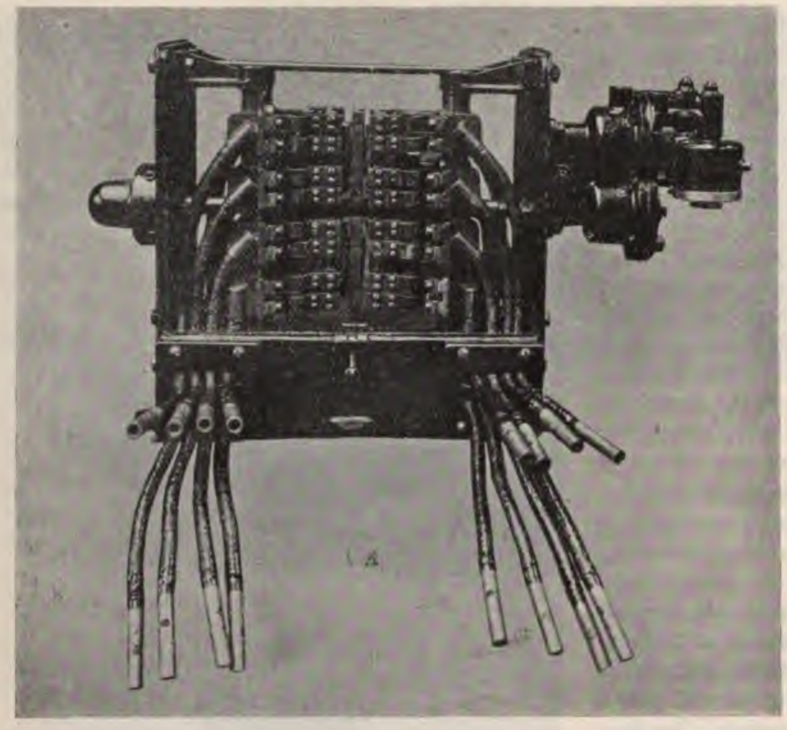


FIG. 6. REVERSER.

has been recognised that through accident or sudden illness, the motor-man may leave hold of the controller-handle, in which case, especially under the latter circumstance, grave consequences may ensue. This is provided for by means of a strong spring action which, when the handle is released, returns it to the neutral position, interrupting *en passant* the circuit of an electro-magnet attached to the air brake. This opens a valve in the main pipe of the system, allowing the air to escape, and the brakes to be immediately applied over the full length of the train.

In ordinary reversing of the train, this arrangement does not operate provided the handle is passed quickly over the neutral points.

The second safeguard is that which prevents any harm being done to the motors if the operator moves the controller-handle rapidly over to the full parallel position. In such case, the speed of working of the turret-controller does not increase, and the various connections passing from first series to full parallel are made automatically at the right pace. This reduction of the human element to a very low value results not only in greater safety and comfort to passengers, but in considerable economy in power consumption amounting to as much as 10 or 15 per cent. over that obtained by ordinary hand-operated methods.

The third provision is a system of interlocking between the control equipment and the power brakes, whereby the controllers throughout the entire train are opened automatically when the brakes are applied, no matter in what position the driver may have or continue to hold the master switch-handle.

AT the half-yearly meeting of the Metropolitan Railway Company, Sir C. McLaren, M.P., referred to the trains which are already running between Baker Street Station and Uxbridge, through Harrow, by the new method of traction. They were, he said, gradually increasing the number of electric trains into and out of Baker Street, and hoped shortly to be able to dispense with steam entirely on that section. So far as the Inner Circle service was concerned, they hoped very soon to run some electric trains on that section also

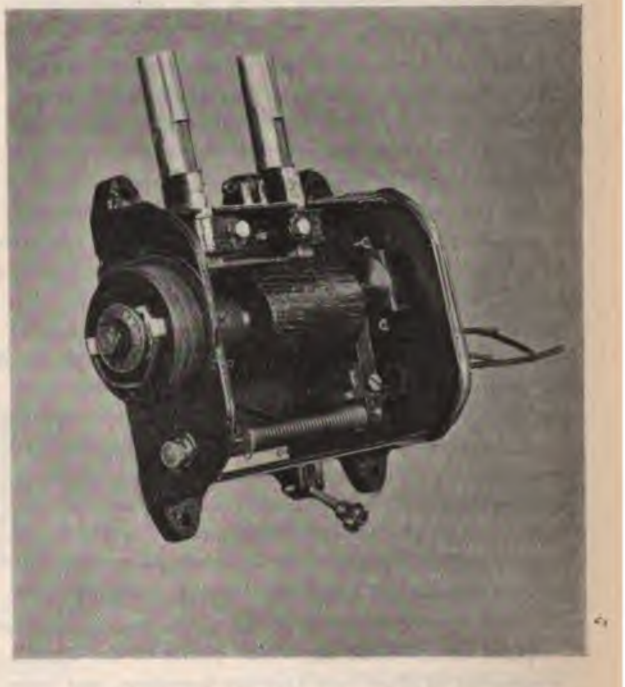


FIG. 7. OVERLOAD AND NO VOLTAGE RELAY.

NAVAL NOTES.

WEEKLY NOTES ON NAVAI PROGRESS IN CONSTRUCTION AND ARMAMENT.

(BY OUR NAVAL CORRESPONDENT.)

GREAT BRITAIN.

WHEN Lord Selborne first gave publicity to the new scheme for the distribution and mobilisation of the British War Fleets, occasion was taken to mention that the Naval manœuvres of 1905 and 1906 would be devoted to the testing of the new arrangements. And since it was obvious that such a test must be world-wide in its operations, and that to be in any measure successful must include all the fleets and squadrons, no surprise has been expressed that the "general idea" of the hypothetical strained relations which are to form the basis of the ships' movements in 1905 has already been published. Time will be required for the Commanders-in-Chief on the various stations to interchange communications with a view to concerted action. This first series of movements being carried out on the hypothesis that relations with some foreign Power or Powers are strained, will not be of a warlike nature. Indeed it will be the tactful and diplomatic officers who will gain the most distinction in the manœuvres.

No more launches of large vessels have taken place, but one more destroyer, the *Wear*, was put into the water on January 21st, by Palmers' Company, and two submarines of the "B" type were launched at Barrow on the 24th of that month. The cruiser *Diamond* has been completed by Messrs. Cammell, Laird and Co., and will be commissioned next week for service with the Particular Service Squadron, being permanently stationed in the West Indies. The *Sapphire*, a sister-ship, has been allocated for duties with the torpedo and submarine flotillas, flying the flag of Rear-Admiral A. L. Winsloe, C.M.G. The *Jed* destroyer has been completed by Thornycroft's, and passed into the reserve with a nucleus crew at Devonport. The armoured cruiser *Argyll* will commence her trials at the end of this month.

UNITED STATES.

The bids for the battleship *New Hampshire* and the armoured cruisers *Montana* and *North Carolina*, are unprecedently low, being eleven per cent, below the aggregate lowest bids for three similar ships which were put out to contract twelve months ago.

The Midvale Steel Company of Philadelphia has commenced delivery of armour plates for the vessels authorised by Congress in 1903, the contract for which they captured from the Carnegie Steel Company, and the Bethlehem Steel Company last year, after these two firms had enjoyed a monopoly of the supply for ten years.

Progress with the vessels in hand continues steady, the first six on the battleship list having gone up two per cent. in their degrees of completion during the past month. The *Vermont*, *Kansas*, *Minnesota*, and *Mississippi*, all went up four per cent. during December, and of the armored cruisers four are now within 7 per cent. of completion. It is expected that in all twenty-one vessels of various types will be completed and commissioned during the coming year, including five battleships, four armoured cruisers, and two protected cruisers, with small craft. The dates announced for the commissioning of the larger vessels are as follows :—

January 30.—*West Virginia* armoured cruiser.
February 13th.—*Pennsylvania*, armoured cruiser.
March 12th.—*Maryland*, armoured cruiser.
October 15th.—*Virginia*, battleship.
October 15th.—*Nebraska*, battleship.
November 12th.—*Rhode Island*, battleship.
December 3rd.—*New Jersey*, battleship.
December 10th.—*California*, armoured cruiser.
December 12th.—*Georgia*, battleship.

SWEDEN.

The Naval programme of 1901 which was to have been completed by next year has fallen so much in arrears that an increased grant has been asked for for 1905, in order that the programme may be completed in 1907. The following is the proposed allotment of this grant. The sums asked for are as follow: For completing the ironclad *Oskar II.*, £140,100; first instalment new ironclad of *Fylgia* type, £123,000 total cost £385,700); completion of torpedo-boat destroyer, £33,400; two torpedo-boat destroyers, £133,500; first instalment five large torpedo-boats, £55,100; nine small torpedo-boats, £99,100; training vessel, £11,600; reconstruction of *Loke*, £29,800; ditto of *Hildur*, *Bjorn*, and *Gerda*, £28,050; three guard boats, £14,100.

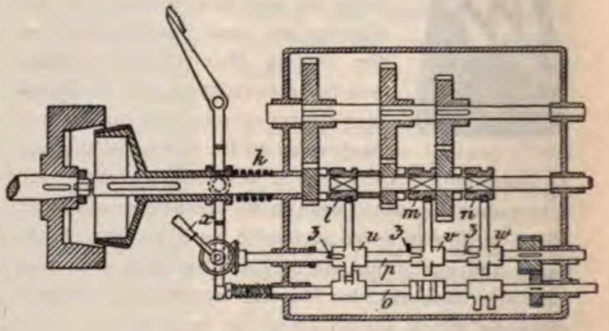
AUTOMOBILE NOTES.

The Palace Show.

The first of the series of London Automobile Exhibitions was opened on Friday at the Crystal Palace. The show will remain open until February 4th, and in connection therewith competitions are being organised relating to motor accessories and non-slipping contrivances. It suffers by comparison with last year's show, but is representative of some eighty exhibitors.

Soames Change Speed Gear.

This system was described in the course of a paper contributed by Mr. Frank Little to the proceedings of the North-East Coast Institution of Engineers and Shipbuilders. As will be seen from the diagram, the gear wheels are always in mesh, and are locked to the shaft, as required, by interlocking jaw clutches, the main clutch being shown on the left. When the clutch pedal is pressed down (the position shown in the diagram), it first releases the main clutch; on being further depressed, it presses the cam shaft, O, against its spring, unclutching the wheel which happens to be engaged, and allows the selection of another gear wheel, by turning the change speed handle, X. This change speed handle, X, turns the rod, P, through the bevel wheels, and this rod turns the shaft, O, by means of the gear wheels shown on the right. This causes one of the three double fingers, which are fixed on the shaft, O, at different angles to one another, to pick up the tail of one of the sliding forks, U, V or W. When the pedal is released and rises, the spring presses the shaft, O, to the left and, through the medium of one of the forks, U, V, W, which has been picked up, slides its jaw clutch, L, M or N, to the left, thus clutching its gear wheel to the shaft.



SOAMES CHANGE SPEED GEAR.

In the diagram the fork, U is shown to be picked up, and as soon as the pedal is released it will make the jaw clutch, L, engage with the shaft, K, thus giving a direct drive, this being the drive on top speed. The shaft, O, when the main clutch is in, is locked out so that the jaw clutch in use is held in position by means of a trigger (which is not shown) and is not dependent on the spring. The pins and slots, Z, on the rod, P, prevent the handle, X, from being moved, except when the pedal is fully depressed, and also prevent any but the selected gear from being engaged, the handle and all gears not in use being definitely locked except when the pedal is depressed. In order to avoid complicating the diagram, the reverse has not been shown, neither does the positive locking arrangement appear. The system is of course applicable to more than the three speeds and is arranged for either gear driving with a live back axle or for chain driving.

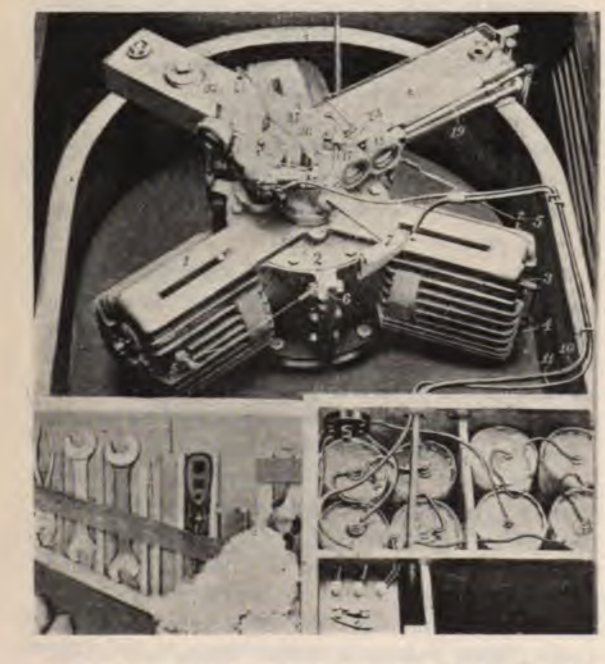


FIG. I. NEW GASOLINE MOTOR BY THE ADAMS COMPANY.

A New Gasoline Motor.

The Adams Company, of Dubuque, Ia., favour us with the accompanying illustrations of a revolving cylinder, air-cooled, gasoline motor, which they have designed with a view to securing compactness, accurate balance, light weight, wide range of speeds and power, and air-cooling qualities. This reverses the ordinary practice, in that the engine cylinders revolve and the crank shaft is stationary. Three units, each being a complete cylinder, with cylinder head and one-third of a central crank case cast in one piece, are bolted together and bolted to a top and bottom cast-steel flange which has bronze bushings, forming bearings around the vertical stationary crank shaft. This forms the revolving unit and the flywheel of the motor. The three pistons are connected to a single crank wrist pin of very large proportions by bronze pitmans. The pitmans, with the pistons at their outer end, swing around the stationary wrist pin. The wrist pin being eccentric with the axis of the revolving cylinder unit causes the pistons to reciprocate back and forth in the cylinder at each revolution of the cylinders. This does not change or stop and return the mass of pistons at each dead centre as with an ordinary engine. It is, therefore, susceptible to a very accurate mechanical balance. The action of the exploding charge is practically the same in this engine as in the ordinary kind.

Air cooling is accomplished by the cylinder revolving at a rapid rate, drawing in the air at the centre and expelling it with great rapidity at the ends of the cylinders. The cylinders are provided with longitudinal ribs, which yield a large radiating surface.

The speed of the motor is controlled entirely by its variable compression system. The carburetter is entirely automatic. Gasoline is pumped through the upper pipe into a constant level reservoir, which is a small cavity covered with a watch crystal enabling the gasoline to be seen. The surplus gasoline flows back into the pump well through the lower tube. The spark is regulated automatically by a device employing a centrifugal governor, which not only advances the spark when the speed of the engine increases, but also increases the length of the contract of the primary circuit. A contact of the primary circuit for $\frac{1}{36}$ of a revolution of the engine gives sufficient time for the spark coil to become saturated and gives a good spark when the engine is running 150 revolutions or less. This contact is automatically increased to about $\frac{1}{12}$ of a revolution of the engine when running at 900 revolutions per minute.

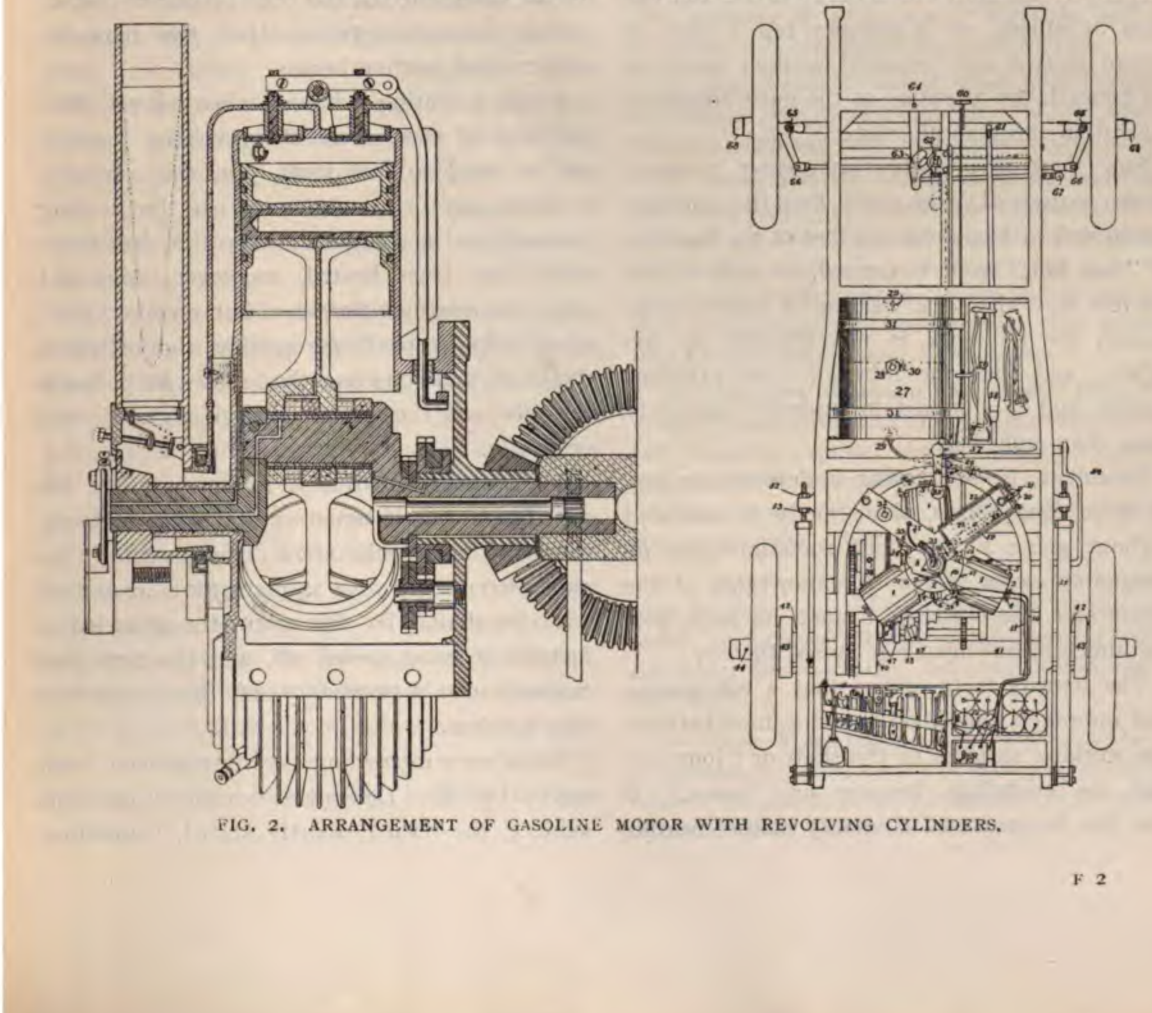


FIG. 2. ARRANGEMENT OF GASOLINE MOTOR WITH REVOLVING CYLINDERS.

RUNNING-SHED NOTES.

BY J. C. R. ADAMS.

I PURPOSE, under this title, to briefly describe what may be called the education of a steam engine, the various adjustments and attentions which are needed before a new engine is fitted to take its place as a useful and economical source of motive power.

There are some items of knowledge which are the common property of the workmen actually engaged in the construction of, or in attendance upon, certain engines or machinery, which are not to be found in printed books, and seldom form the subject of papers addressed to technical audiencies. But in discussing the processes of the workshop and the methods adopted by the man who actually carries out the ideas of others, we sometimes tap a vein of human insight and practical wisdom which is not beneath the attention of the most advanced student of mechanical science.

Now there is probably no greater nuisance known to users of steam power than the tendency manifested by some one or other of the bearings to "run hot," as it is termed, in spite of the possible fact that the bearing is amply large enough for its work, is not screwed up too tightly, and that the lubricant is of excellent quality and is supplied in quantity obviously more than sufficient.

Of course, if the bearing is defective in any of these four points, the remedy is indicated without going further, but sometimes, for no assignable cause within the knowledge of the steam-user, the bearing cannot be kept cool and much inconvenience is caused thereby.

The remedy is to ensure that a continuous, and unbroken film of oil is maintained between the working surfaces of the shaft or "journal," and its encircling bearing or "brass." If this film be preserved obviously neither heating nor destructive wear can take place. The only problem is, how to preserve it ?

Imagine for a moment instead of the film of oil, a series of small cylindrical rollers interposed between the journal and the brass. If the shaft be now revolved the ring of rollers will rotate, as a whole, around the shaft, at the speed of their own centres, which is of course midway between the peripheral speed of the shaft and the stationary brass, with both of which the rollers are in surface contact. The film of oil does exactly the same thing—it strikes the mean between the fixed and revolving surfaces, and it will continue to do this unless the pressure is sufficient to squeeze it out from between them, or, unless it be scraped or peeled off the shaft by the sharp edge of the brass, when of course, contact ensues between the two metallic surfaces and heating begins.

Again, a bearing in halves, when heated, does not expand away from the revolving journal, and so tend to free itself. On the contrary, it closes upon the shaft and so the heating proceeds in a compound ratio. A half-brass which has been heated, moreover, does not regain its original diameter, but remains, even after being cooled, perceptibly tighter upon the shaft, and consequently a looser fit between the jaws of the plummer-block than it was originally.

The remedy for this is to scrape away the metal of the half brass from the edges downwards so that only about one-fourth of the circumference, or ·7854 × diameter is in contact with the shaft. By this means the oil is led in instead of being peeled off, and the first step towards the maintenance of the continuous film is taken.

Some very interesting experiments have been made by Mr. Dewrance, bearing upon this subject, the results, shortly stated, being that for effective lubrication the oil must be fed in at the point of least pressure, and that a gradually decreasing space must exist between the surface of the brass, and its shaft, or journal. by which the oil may be, literally, induced to enter the actual bearing surface.

Herein, he only demonstrates the theory of the well-known practice of "easing away" the brasses at the sides. From this we deduce the fact, that in bearings such as those of the connecting-rods of horizontal engines, when the brasses are divided vertically, and the lubrication introduced at the top, no oil-channels are needed; while in the main bearings of the same engine the oil should be introduced at the sides of the bearing. being brought thereto either, as he suggests, by external oil-pipes, or by internal grooves or channels cut into the internal surface of the upper bearing.

Heavy shafts, such as the main bearings of large horizontal or vertical engines, should be fitted with oil pumps for continuous feeding, while for quick revolution engines, forced lubrication under pressure possesses such important advantages that its use is becoming almost exclusively adopted for engines of any size. But whatever system be adopted the entrance of the oil at the point of least pressure is desirable.

There is one more important condition to be observed. In bearings which are fitted between fixed collars it must not be forgotten that a little end play is necessary. The slightest pressure endwise upon such a bearing is sufficient to set it heating, and the expansion thus produced aggravates the evil, and would soon bring the engine to a standstill, if not observed in time. These are the points requiring observation and correction in the case of new engines, so far as the bearings are concerned, and it is thought that the hints which experinece in the trial running of new engines have suggested to the author may be of service to users of engines whose bearings are inclined to give trouble.

OBITUARY.

We regret to see in the Continental journals the announcement of the death of Joseph Chaudron, the veteran Belgian mining engineer, at the age of 82. He was educated at the Liége School of Mines, and in 1842 entered the Belgian Government service, which he quitted ten years later to devote his attention, in connection with the German boremaster, Carl Gotthelf Kind, to perfecting the method of boring shafts that throughout the world is known by their names. Under Chaudron's direction from 1854 to the present time, upwards of 80 shafts have, in England, Belgium, France and Germany, been successfully bored for depths of as much as 400 yards through quicksands, and mineral resources to the value of many millions of pounds thereby rendered available. The latest application of the Kind-Chaudron method is now in progress at the Dover Colliery.

There is general regret at the news of Mr. Charles Horsley's death. He was associated with some famous engineering works, notably the tubular bridge over the Menai Straits, but was probably best known as consulting engineer and London representative to Messrs. Oakes and Co., of Alfreton. Mr. Horsley was the inventor of a gas exhauster, and a syphon, had been president of the Society of Engineers, and was a member of the Institution of Civil Engineers.

Mr. John Howard Richardson, whose death is reported at Croydon, was the superintendent of the London Brighton and South Coast Railway for twenty years.

Mr. Alfred Smedley, of Belper, whose death took place last week, was a well-known member of the Midland iron trade. He and his brothers established the Eagle Ironworks a good many years ago, and Mr. Alfred Smedley took an active and leading part in the management until his retirement. The deceased took a considerable interest in local affairs.

Our American contemporaries report the death of Mr. William Barnet Le Van, a well-known mechanical and consulting engineer, who had made his home in Philadelphia for many years. He was an authority on steam and steam boilers, and was the author of several books upon those subjects.

Mr. Samuel Forter, news of whose death comes from Pittsburg, was the inventor of the Forter water sealed gas producer, Forter sealed reversing valve, and Forter furnace charger, and other devices used in steel works.

The death is announced of Mr. Benjamin Davey, of Redruth, a well-known mine manager and metallurgist. He gained his early experience in the service of Messrs. John Taylor and Son.

OUR WEEKLY BIOGRAPHY.

MR. GEORGE JACKSON CHURCHWARD, M.Inst.C.E., M.I.Mech.E.

READERS of our "Locomotive Notes" will be quite familiar with the name of Mr. G. J. Churchward, the chief of the mechanical engineering department of the Great Western Railway. Born in 1857 at Stoke Gabriel, Devon, he gave evidence, when quite young, of a strong bias for matters pertaining to mechanics, and at the conclusion of his primary education he decided upon becoming a mechanical engineer; he was therefore articled to Mr. John Wright, locomotive superintendent of the South Devon and Cornwall Railways, and under this expert's direction, he acquired a sound knowledge of the profession which he has followed with noteworthy success.

From the G.W.R. Magazine.

MR. G. JACKSON CHURCHWARD, M.INST.C.E., M I.M.E

Mr. Churchward went to Swindon in 1876, about the time when the amalgamation was effected between the South Devon and Cornwall lines and the Great Western Railway. His first appointment was in the drawing office, and subsequently he became inspector of materials. In 1881 he was selected for the position of assistant to Mr. James Holden, the manager of the carriage and wagon works, and on Mr. Holden's retirement from the post, he was appointed his successor. A few years later he undertook the management of the locomotive works, and some time afterwards he was again promoted, and made first assistant to Mr. William Dean, who was then the head of the mechanical engineering department. In 1902, Mr. Dean retired from the service of the Great Western Railway Company and Mr. Churchward was appointed chief, which position he now holds.

When Mr. Churchward first became associated with the Great Western, the Company's rolling stock was as follows:—

Locomotives, 1,471; Passenger vehicles, 4,177; Goods vehicles, 32,303.

A remarkable increase is shown at the present day, the stock now amounting to:—

Locomotives, 2,279; Passenger vehicles, 7,102; Goods vehicles, 63,086.

During recent years the steadily increasing weight of express passenger trains, together with the keen competition to secure through traffic, has led Mr. Churchward to design and construct some powerful locomotives, details of which have already appeared in PAGE'S WEEKLY.

Mr. Churchward is a member of the Institution of Civil Engineers, and of the Institution of Mechanical Engineers; in 1900 he was elected first Mayor of the Borough of Swindon.

Japanese Field and Mountain Artillery.

THE field gun, illustrated on page 246, consists of the tube *A*, the jacket *B*, the trunnion band *C*, carrying the trunnions which are lengthened out on either side, and thus serve also as the axle of the piece, the locking ring *D*, and the front ring *E*, which locks the jacket to the tube. The gun is of forged steel, and is painted a snuff-colour.

At the breech end (fig. 2) on the underside are two projections *H* between which the arms *J* of the carrier fit and are held by the pin *G*. On top of the breech is the seat *K* for the pointing arc, and on the right side is a tubular projection *F*, perpendicular to the axis of the piece, which holds the sight in direct fire or the direction plate in indirect fire.

The breech mechanism is of the interrupted-screw type and opens downwards. It consists of the carrier *L*, the breech block with its threaded sectors *M'*, the angular operating lever *MNQ*, the extractor and firing mechanism. The carrier, as above stated, is hinged to the breech of the gun on the lower side. The cylindrical breech block has its threads cut away over one quarter of the circumference in two places, likewise the breech housing of the tube, so that when the breech block is pushed in, a quarter turn locks it. The breech block is screwed in the carrier and can be rotated in the latter one quarter of a revolution. It is bored out axially to receive the firing mechanism. Towards the top of the carrier is the operating lever *MNQ*, which turns about *M*. It has a horizontal arm *NM* and a short vertical arm *MQ*; the short arm carries a stud which engages in the slot *Q* in the breech block, and in opening and closing the breech serves to rotate the breech block the required amount. The operation of opening the breech is then evident. The operating lever is raised until the arm *NM* is vertical, whereby the short arm becomes horizontal and the breech block is turned through one quarter of a revolution. The slot *Q* is then in the dotted position *Q'* (fig. 2), the screw threads of the block are disengaged from the female threads of the breech housing, and the block is locked to the carrier by means of the locking bolt *R*. The carrier, together with the block, is then pulled down to the rear until it comes into the horizontal position, in which it is held by a suitable support (dotted lines, fig. 3). Closing the breech is performed in the inverse order.

The firing mechanism consists of the firing pin with its striker, the main spring, another small spring, and the trigger *S*. The two springs are assembled one behind the other; the main spring is compressed and the firing pin armed by closing the breech. If the breech block is not fully closed a safety device prevents the piece from being fired. The normal position of the striker is regulated by the small spring, whereby the cap of the cartridge is protected from accidental blows of the striker. The details of the firing mechanism and the trigger device are shown in figs. 2 and 3.

The extractor *T* lies in the lower part of the breech recess and is operated by an arm *U*. This arm is mounted on the same pin *V* that serves as hinge-pin for the carrier, and in its recess has a motion to the front and rear about this axis. On the lower side is a stud *W* against which the carrier strikes when the breech is opened; the arm *U* rotates to the rear actuating the extractor *T*, which ejects the cartridge case.

CARRIAGE.

The trail consists of two pressed steel flasks with curved edges, suitably tied together by transoms. The front end of the trail is reinforced by stiffening plates *A*, bolted on and so constructed as to form the trunnion beds of the gun. The trunnions extend through them and carry the wheels of the carriage at their outer ends. Near the middle of the flasks of the trail the road brakes are hung by tie rods *B*. The recoil brake lies at the lower end of the trail between the flasks. At the end of the trail are the trail shoe *C*, the pintle ring *D*, two trail handles *E*, and the folding trail-handspike *F*. The carriage also has axle stay-rods *H* and two axle seats.

The elevating mechanism is on the right cheek of the trail, and consists of the worm *N*, with hand-wheel *M*, the worm-wheel *L*, and the pinion *O*, the teeth of which engage in those of the elevating rack on the gun.

For checking recoil and returning the piece to battery use is made of the recoil brake and wheel-shoes which replace a trail spade. The recoil brake is arranged as follows: On the inner side of the nave of each wheel is a grooved rim in which a traction rope runs (fig. 5). The ends of these ropes are fastened one end to the wheel-shoe and the other to the cross-head *P* (fig. 3) of the piston rod (dotted lines, fig. 5, side elevation). In the flasks of the trail there are grooves in which this cross-head slides. When the cross-head is pulled forward by means of the ropes the cup-shaped springs (Belleville) of the brake are compressed. The wheel-shoes are hung from the axle by chains and have spade-like projections on the underside, which sink into the ground when the wheels on recoil force them down. In firing, at the beginning of recoil, the wheels turn and

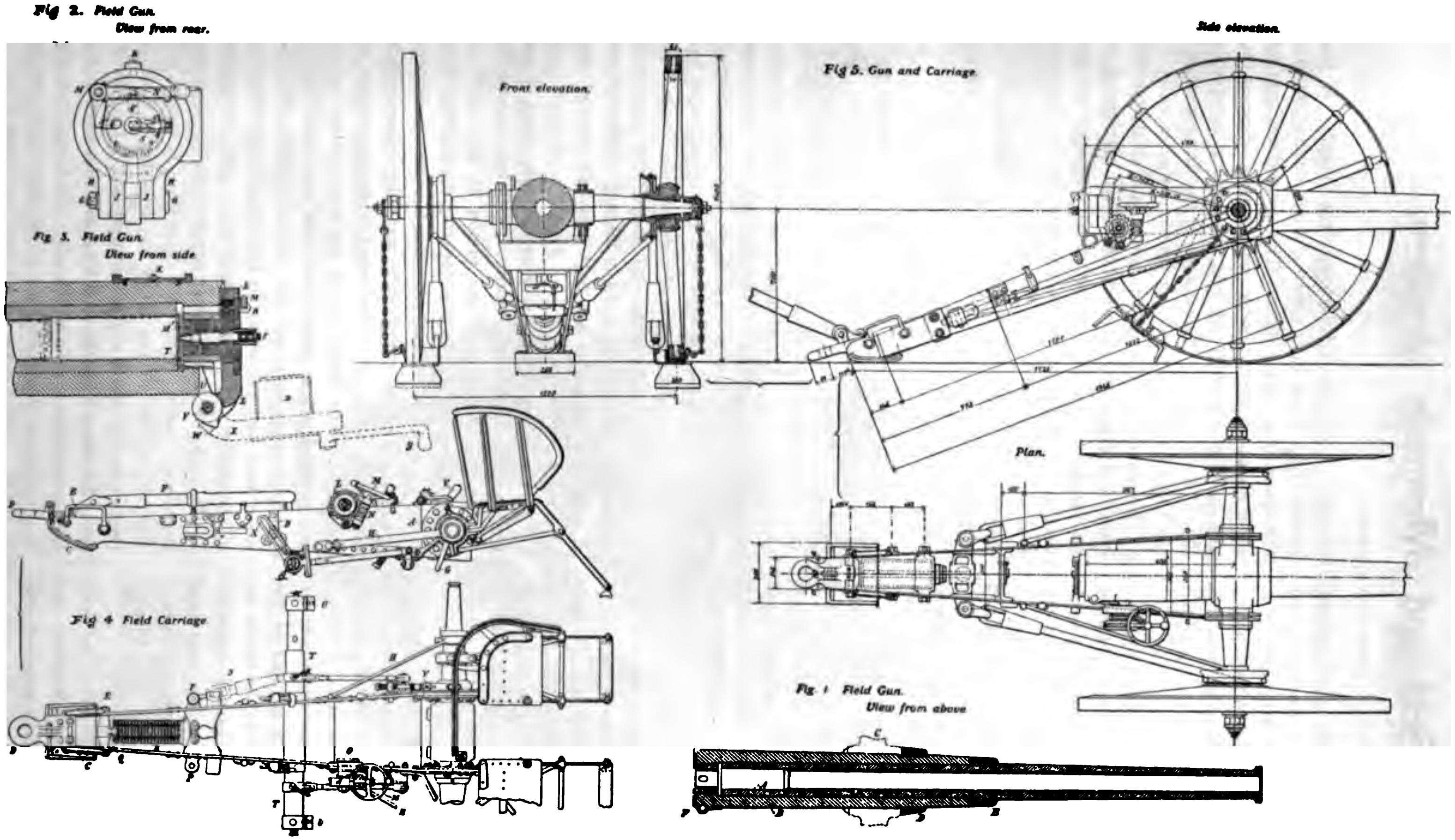


Fig 2. Field Gun. View from rear.
Fig 3. Field Gun. View from side.
Fig 4 Field Carriage.
Front elevation.
Fig 5. Gun and Carriage.
Side elevation.
Plan.
Fig 1 Field Gun. View from above.

JAPANESE FIELD AND MOUNTAIN ARTILLERY.

	FIELD GUN.	MOUNTAIN GUN.
Calibre	75 mm	75 mm
Length of gun	2·2 m	1 m
Length of bore	1·86 m	0·8 m
Number of grooves	28	28
Twist	7°	7°
Depth of grooves	0·75 m	0·75 mm
Diameter of wheels	1·4 m	1·0 m
Height of axle	0·7 m	0·5 m
Height of line of sight	50 cm	70 cm
Length of line of sight	70 cm	40 cm
Value of a division on the sight and pointing arc	1/1000 R	1/1000 R
Value of a division on the direction plate	3/1000 R	3/1000 R

	FIELD GUN.	MOUNTAIN GUN.
Shrapnel, weight	6 kg	same as for field gun
bursting charge	92 gm	
number of bullets	234	
weight of a bullet	10·7 gm	
diameter of a bullet	12·5 mm	
Explosive shell weight	6·1 kg	
bursting charge	800 gm	
Muzzle velocity	1500 f.s.	900 f.s.
Track	1·2 to 1·3 m	0·7 m
Weight of gun	316 kg	100 kg
of breech block	16 kg	—
of gun with carriage	846 kg	290 kg
Limits of elevation	— 11° to + 19°	— 10° to + 30°
Weight of powder charge	450 gm	——

run up on the wheel-shoes, whereby further motion is stopped. At the same time the ropes wind on the naves and draw the cross-head forward, compressing the springs and thus checking the recoil. The wheel-shoes firmly embedded in the ground, prevent the carriage from sliding to the rear. When the pull on the rope stops, the springs run the whole system forward, the wheels rolling off the shoes. The average length of recoil is 0·5 m. Although the piece is thus run forward after fire, it does not always come nto exactly its original position; it has to be relaid after each round, which diminishes its rate of fire.

On account of this recoil and the operation of the breech mechanism, which requires two motions in either opening or closing the breech, the Japanese field gun cannot be included in the class of true rapid-fire guns, but only in that of guns with accelerated fire, as for example, the German field gun, model 1896.

The road brake *T* is so arranged that it can be placed lower, as is necessary when the gun must fire at great angles of elevation. This brake is operated by the crank handle *V* on the left side of the carriage. The wheels have sixteen spokes and a metal nave. The mountain gun differs but slightly from the field gun.

Parallel Drive, Lever Release Screwing Machine.

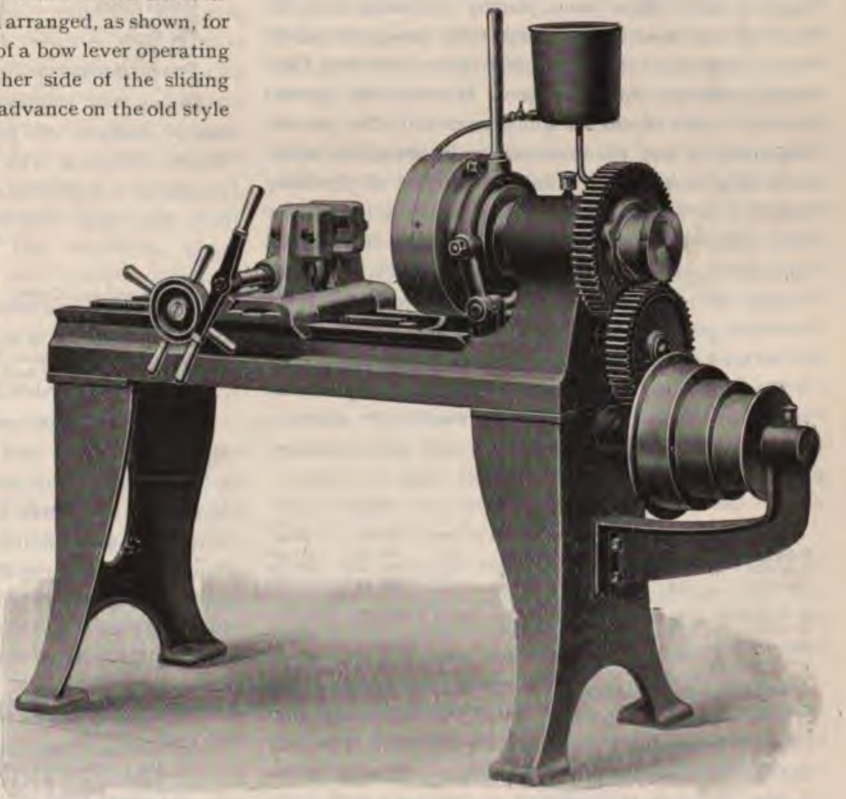
BY MESSRS. CHARLES WINN AND CO., OF BIRMINGHAM.

THE new design of screwing machine for tubes and bolts illustrated herewith has been designed by Messrs. Charles Winn and Co., of Birmingam, with a view to obtaining a neat and compact parallel drive.

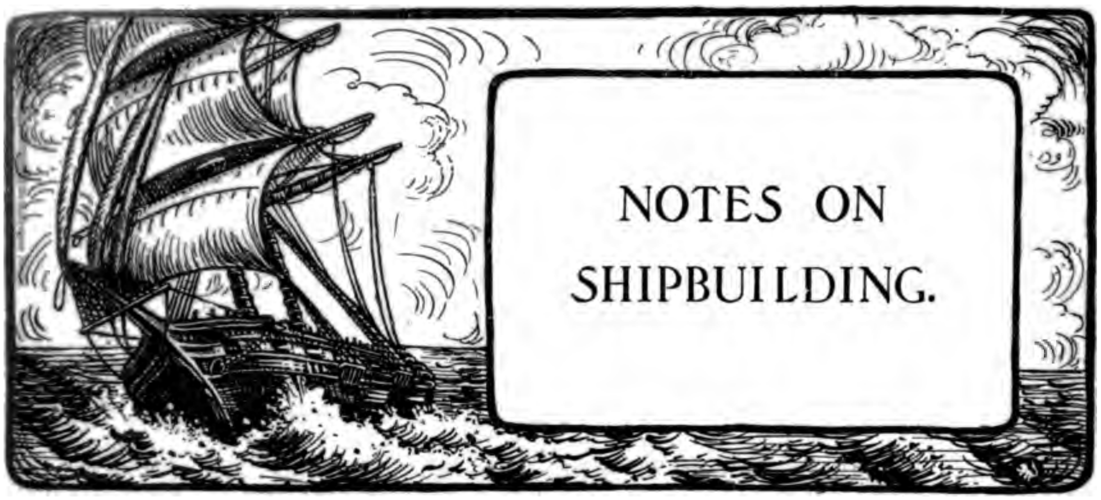
The dies are of the chaser type, readily adjustable to either standard sizes or odd sizes. Each of the dies consists of a set of four chasers, and arranged, as shown, for instantaneous release by means of a bow lever operating gun-metal slippers fitted on either side of the sliding head, and offering a considerable advance on the old style of lever release. This gives a smooth, easy, motion, which opens the dies by a single movement, and releases the work without stopping the machines; the dies reset to exactly the same diameter as before by a reverse action. There is no interference with the original adjustment, so that any desired diameter of screwing can be exactly repeated by an inexperienced operator.

The vice is of the firm's duplex self-centring pattern; the die spindle is hollow and provided with a cap at the back end to prevent swarf falling into the gear wheels below, but it is, of course, detachable for the necessary removal of the swarf from the inside of the spindle.

A double spur gear is provided having a ratio of 11 to 1, with a three-speed cone pulley having a 2½-in. face for belt. The machine is arranged with an extra long bed providing for 24-in. travel of the work. It is fitted with wheel guards which have been removed for the purpose of illustration.



PARALLEL DRIVE LEVER RELEASE SCREWING MACHINE BY MESSRS. CHARLES WINN AND CO., OF BIRMINGHAM.



NOTES ON SHIPBUILDING.

IN the shipbuilding world the unexpected has happened since the new year, for there has been a quite considerable run of orders in most of the important districts. Many owners who have been holding back, have been placing contracts, and we hear of one firm in the north who have ordered no fewer than ten very large cargo boats, dividing their orders between three builders. Whether the present revival will expire as quickly as did that at the beginning of last year remains to be seen, but whatever shipowners may think of it, the shipbuilding industry is feeling rather better than it did. The new work is, however, very unevenly distributed. Another unexpected thing in the trade is the large output of 1904, which, although below that of the previous year in the whole world, has turned out to be rather better than was anticipated.

The following table condenses the shipbuilding work of 1904 for the whole world. It shows a reduction of 109 vessels of 225,966 tons, and an increase of 15,554 i.h.p. as compared with 1903:—

	1904.			1903.		
	Ves.	Tons.	i.h.p.	Ves.	Tons.	i.h.p.
Scotland ...	399	448,235	462,140	362	484,853	497,396
England ...	700	849,651	819,482	871	764,105	725,470
Ireland ...	25	78,224	57,530	25	158,482	128,451
U. K. Totals	1,124	1,376,130	1,338,972	1,258	1,407,440	1,351,317
Colonies ...	84	25,086	11,066	96	37,225	12,966
Foreign Countries	1,124	1,050,783	1,016,361	1,087	1,233,300	986,562
Grand totals	2,332	2,451,999	2,366,399	2,441	2,677,955	2,350,845

The reduction in the United States brings that country below the level of the Clyde, which, last year did more than any other shipbuilding district in the world. In 1903 the order of the foremost half-dozen districts was different from 1904. The United States was first and the Clyde second. The Tyne was third, Germany fourth, the Wear fifth, and the Tees and Hartlepool sixth. The following is the order for 1904:—

	Vessels.	Tons.	i·h.p.
The Clyde	329	417,870	432,815
United States ...	154	324,175	334,035
Germany	282	271 942	181,927
The Tyne	134	258,229	307,860
The Wear	73	228,932	154,185
Tees and Hartlepools	70	210,470	115,720

Among the leading shipbuilders of the year are many changes of position. Messrs. Harland and Wolff, of Belfast, who in 1903 had an output of eight vessels of 110,463 tons, had in 1904 only six vessels of 31,842 tons. The following is the year's order for 1904:—

	Vessels.	Tons.
Russell and Co, Clyde	18	73,689
Swan, Hunter, and Wigham Richardson, Tyne	22	59,852
Wm. Gray and Co., Hartlepool	18	57,357
Wm. Doxford and Sons, Wear	14	53,050
J. L. Thompson and Sons, Wear	12	44,270
Workman, Clark and Co., Belfast	12	44,272

The largest indicated horse-power reported is by Messrs. Schneider and Co., of Crewsot, who engined a very large number of torpedo-boat destroyers. Next is the North-Eastern Marine Company of Wallsend and Sunderland. Messrs. Cramp, of Philadelphia, and the American Shipbuilding Company were third and fourth in 1903 and 1904. Messrs. John Brown and Co., and Messrs. Richardsons, Westgarth and Co., are further down in the list:—

	i.h.p.
Schneider and Co., Crewsot	107,200
The North-Eastern Marine Company (two shops)	102,660
Hawthorn, Leslie and Company, Newcastle	76,800
The Union Ironworks, U.S.A.	74,360
The Newport News Company, U.S.A. ...	60,550
Cammell, Laird and Co., Birkenhead ...	56,800

The Clyde and Belfast in 1903 launched the largest merchant vessels. Except the *Caronia* there was nothing however to compare with Messrs. Harland and Wolff's four huge steamers of 1903 and the two great freighters launched in that year by the Eastern Company of New York. The smallest vessel of the first half dozen in 1904 was 15,378 tons, and the largest was 23,763 tons. In 1904 there were :—

Vessel.	B. T. Tons.	Builders.
Caronia	21,150	John Brown and Co.
Victorian	11,400	Workman, Clark and Co.
Virginian	11,200	Alex. Stephen and Sons.
Caledonia	9,500	D. & W. Henderson and Co.
Prinz Eitel Friedrich ...	8,865	The Vulcan Co., Stettin.
Dover Castle	8,500	Barclay, Curle and Co.

The following table summarises the Glasgow Herald returns of work in the Scottish shipyards during the past year. It shows an increase of 37 vessels, a decrease of 36,618 tons, and a decrease of 35,253,i.h.p :—

	1904.			1903.		
	Ves.	Tons.	i.h.p.	Ves.	Tons.	i.h.p.
The Clyde ...	329	417,870	932,815	277	446,869	455,221
The Forth ...	27	11,219	10,250	30	15,356	13,415
The Tay ...	15	10,415	9,120	19	16,223	19,460
The Dee ...	28	8,731	9,955	36	6,405	9,300
	399	448,235	462,140	362	484,853	497,396

Trade was not good in the shipbuilding yards of the Clyde district in 1904, but it was not so bad as in 1903. The depression of 1903 extended well into 1904. A total of 417,870 tons indicates that in spite ot the dull trade which prevailed during the spring and summer a great deal of work was done. Tonnage is a reduction of 99,107 tons from the total of 1902, which was a record, and for figures as low we have to go back to 1897. when the total was 310,037 tons. The reduction on the year would have been much greater had it not been for the launching of an exceptionally large number of small coasting steamers, lighters, etc. Altogether, Clyde builders turned out 329 vessels of 417,870 tons. as compared with 277 vessels of 416,869 tons in 1903. In 1903 the average size was 1,613 tons, in 1904 the average is only 1,270 tons. This does not indicate that there were not many large vessels floated, but only that there was also a large number of small vessels. Only one, the Cunard steamer *Caronia*, was over 20,000 tons; two, the cruiser *Argyll* and the Allan turbine liner *Virginian*, were between 10,000 and 12,000 tons. One, the Anchor liner *Caledonia*, was between 9,000 and 10,000 tons, and one, the *Dover Castle*, was between 8,000 and 9,000. Of intermediate sizes the majority were between 2,000 and 4,000 tons, a size of which about 46 vessels were launched, mostly cargo steamers. It is when we come down below 1,000 tons that the ships which run up the numbers of launches and decrease the average size are found. Between 500 and 1,000 tons 40 were floated; between 100 and 500, there were 90; while under 100 tons there were 40.

The honour of recording the largest tonnage in the world belongs to the Clyde, Messrs. Russell and Co. being first with 73,689 tons. They were second in the Clyde in 1903, owing to the fact that Messrs. John Brown and Co., Clydebank, had two war vessels in their list; but previous to that they produced the largest tonnage for half a dozen consecutive years In 1904, Messrs. John Brown and Co. had only 23,150 tons. Messrs. Russell and Co.'s large tonnage is followed by that of Messrs. Charles Connell and Co., Clyde, who had over 40,000 tons, and Messrs. Barclay, Curle and Co., Partick, who had 36,000 tons. With the exception of Messrs. Russell and Co.'s figures, there is no very outstanding total on the river, but all the leading firms had respectable tonnages, while several had large increases. The largest increases after Messrs. Russell and Co.'s, are those of Messrs. Charles Connell and Co., from 28,908 tons to 40,956; Messrs. Barclay, Curle and Co., from 20,944 to 36,408; and Messrs. A. MacMillan and Son, from 9,353 to 18,048.

The distinctive vessels of the year were undoubtedly the Allan turbine liners (one of which, the *Virginian*, was launched by Messrs. Alexander Stephen and Sons, Glasgow), and the Cunard liner *Caronia*, launched at Clydebank. The *Virginian* will be notable as one of the first pair of turbine steamers in the Atlantic trade. The *Caronia* is one of the largest vessels yet built in the world and is one of the finest in the Cunard fleet in the way ot internal fittings and arrangements. One next interesting feature of the year's work is that of Messrs. William Denny and Brothers, Dumbarton. This firm launched no fewer than seven turbine steamers, a record which even they are not likely to surpass until the turbine becomes practically the universal form of marine engine. Other turbine vessels launched on the river were the *Virginian* already mentioned and the yacht *Narcissus* from the yard of the Fairfield Company. The *Narcissus* is a departure from the hitherto accepted plan of having triple shafts and screws in turbine-propelled vessels. She has ordinary twin-screws.

Of the old-time sailing ship, half a dozen may be found in the list. Messrs. A. MacMillan and Son, Dumbarton, launched a barque of 1,800 tons for Aberdeen; Messrs. William Hamilton and Co., Port Glasgow, two barques, each of 3,000 tons for Hamburg; the Grangemouth and Greenock Company, a barquentine of 2,000 tons for Hamburg and a training ship of 2,000 tons for Antwerp; and Messrs. A. Rodger and Co., Port Glasgow, a sailing ship of 1,900 tons for Hamburg. Apart from these, the "sailers" were all barges, lighters, and yachts.

MACHINERY FOR TEA ESTATES.

IT was inevitable that with the march of time imperfect and primitive methods of tea manufacture, dependent, for the most part, upon coolie labour, should give way to machinery from the western world. That the hand and foot of the coolie formerly employed in the various stages of the manufacture have happily been eliminated is certainly calculated to enhance the æsthetic joys of the tea drinker. Machinery, moreover, performs the many little niceties incidental to the manufacture with scientific accuracy. A poineer in this field is Mr. S. C. Davidson, M.I.M.E., of the Sirocco Engineering Works, Belfast, and to Messrs. Davidson and Co., Ltd., we are indebted for the following details of modern tea machinery.

LEAF WITHERING.

The freshly-picked leaves of the tea plant, brought in baskets to the factory in a crisp and brittle condition, are first carefully weighed, and then spread out on shelves or racks in the withering lofts, in order to produce the soft limp state which is necessary for subsequent manufacture, and it is here that Messrs. Davidson's Sirocco system of tea leaf withering is able to secure the desired results independently of climatic conditions. The system involves the mechanical movement and control of the entire volume of air in the withering loft by use of "Sirocco" fans, and special means are taken for directing the flow or air current over the leaf spread on the racks. Messrs. Davidson's system enables the process to be carried out in from 12 to 16 hours, even under the most unfavourable climatic conditions, whereas, ordinarily, 48 to 60 hours would be necessary, or even longer in very moist weather. The spreading surface for withering can be reduced as the withering of each day's leaf is ensured. The "Sirocco" system is arranged strictly in accordance with the particular needs of each factory.

ROLLING MACHINERY.

As soon as the tea is sufficiently limp to take a twist without breaking, it is put into the rolling machine, an example of which is shown in fig. 1, the object of this process being to break up the cells of the leaf prior to fermentation. This machine takes a charge of about 300 lb. to 350 lb. of withered leaf, which represents the effective work of about 100 coolies. When in the rolling machine the leaf is subjected to a strong lateral pressure by the movement of the table under the hopper, in which what are termed "ploughs" are fitted. This movement causes, as it were, a boiling up motion in the centre of the mass of leaf, whereby the leaf receives a remarkably equal and well twisted rolling, and at the same time is kept cool throughout its entire mass.

ROTARY SIEVE.

The leaf, or wet roll, as it is then called, is next passed through a rotary sieve, which serves to break up any unsuitable aggregations of leaf, and separates the finer tea from the coarse, so that in the subsequent fermenting process the different classes of leaf can be fermented separately and best results obtained, as the finest qualities, which ferment fastest, can be dried off as soon as they have obtained a sufficient degree of fermentation.

DRYING THE LEAF.

The drying of the leaf after fermentation is one of the most important features of the tea manufacture and considerable ingenuity has been shown by Messrs Davidson and Co., Ltd., in producing various types. of drying machines to suit all requirements, and in sizes to deal with from 40 lb. to 350 lb. of fully dried tea per hour. These drying machines are made in two distinctive types, viz: "Downdraft" and "Updraft." In the former (an example of which is shown

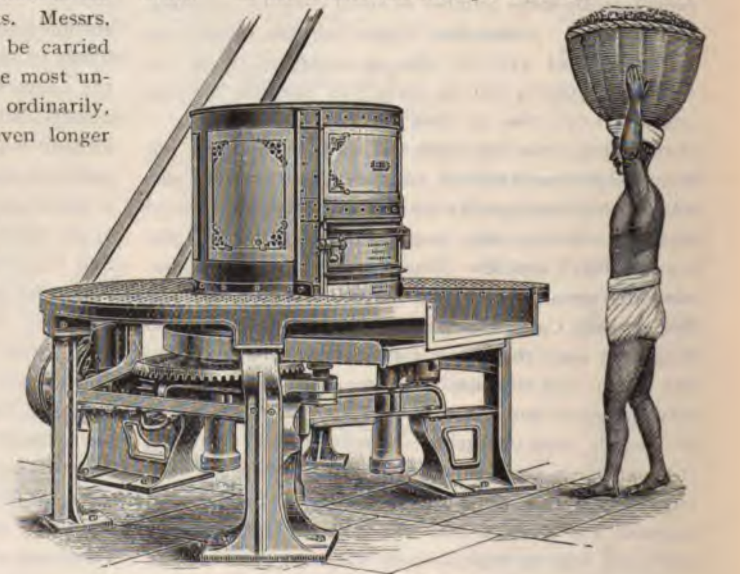
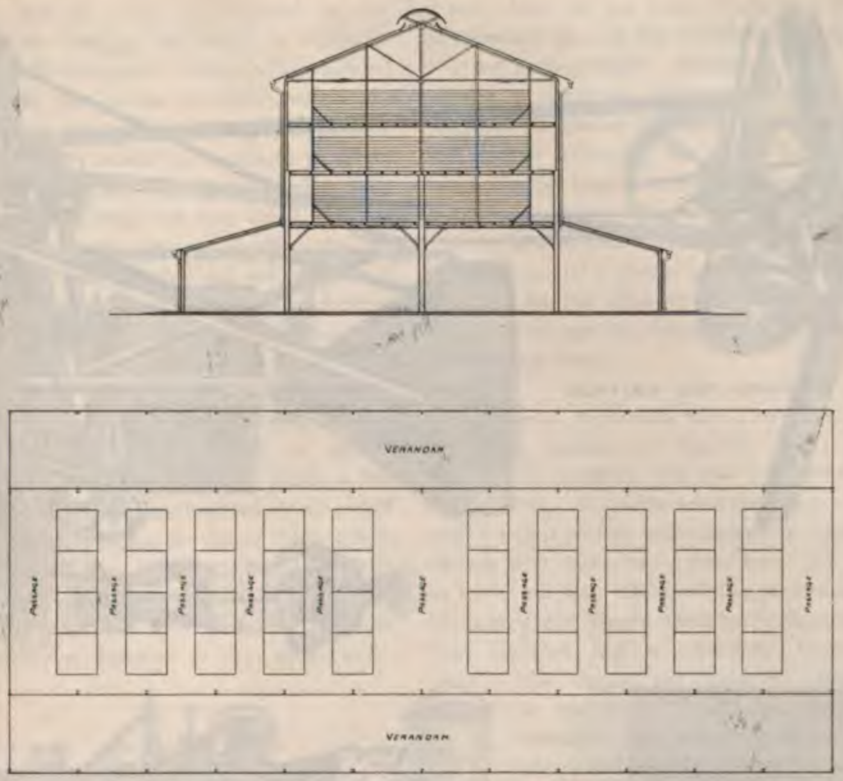
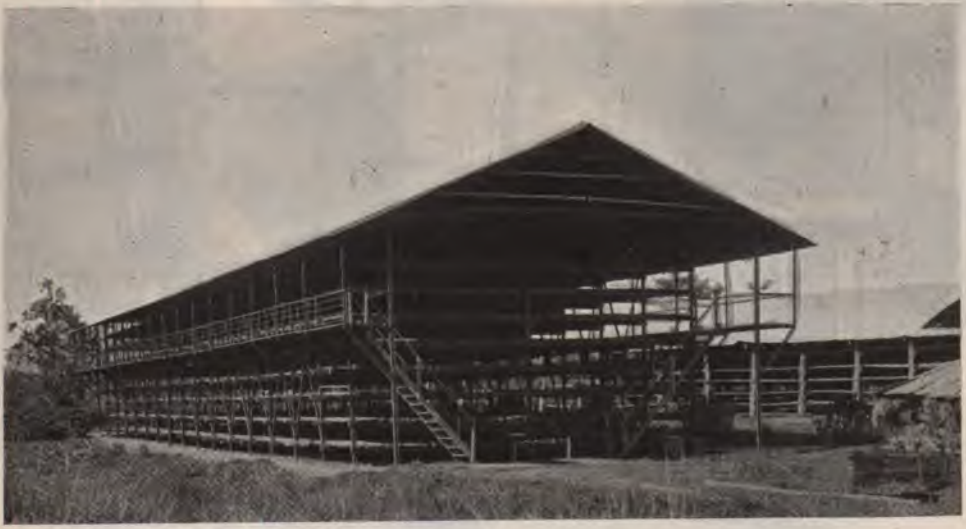


FIG. I. ROLLING MACHINE.



PLAN AND ELEVATION OF AN IMPROVED TEA-HOUSE,

Illustrating the latest improvements in the design of Tea Factories as carried out by Messrs. Brownlie and Murray, Ltd., of Glasgow. The standards of the withering racks are carried up to the roof principal, and the withering trays are placed across the building, thus giving effective drying accommodation.



A TYPICAL LEAF-HOUSE,

Erected by Messrs. Brownlie and Murray, Ltd., on the Kelly-den Tea Estate, India. The building has open sides, is 175 ft. long by 34 ft. wide, and has eight withering lofts. The floors are of timber.

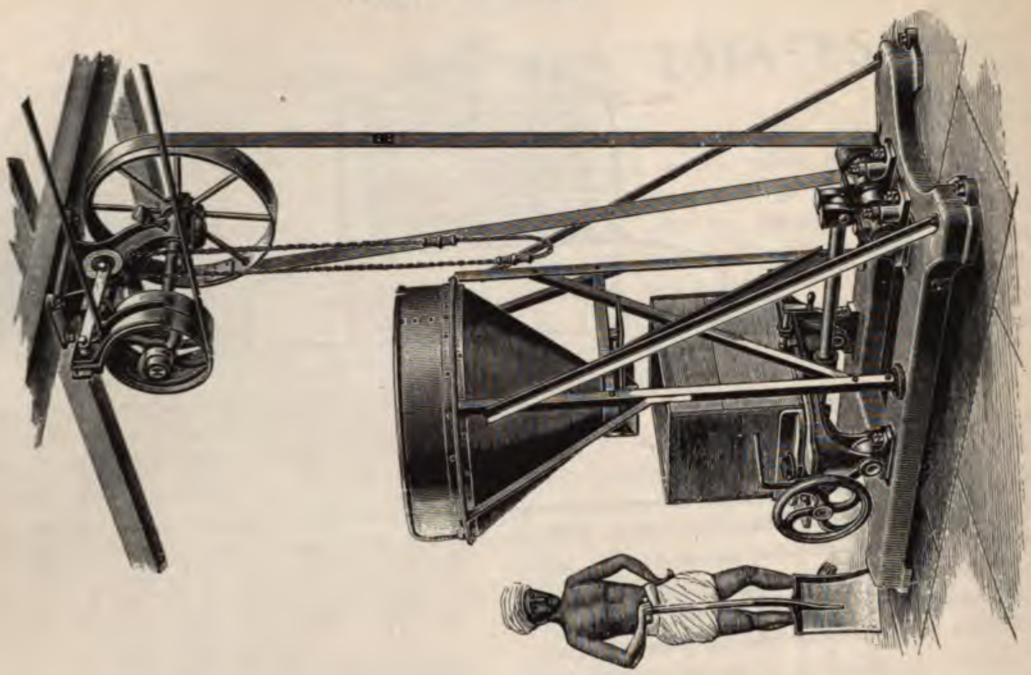


FIG. 5. TEA PACKER.

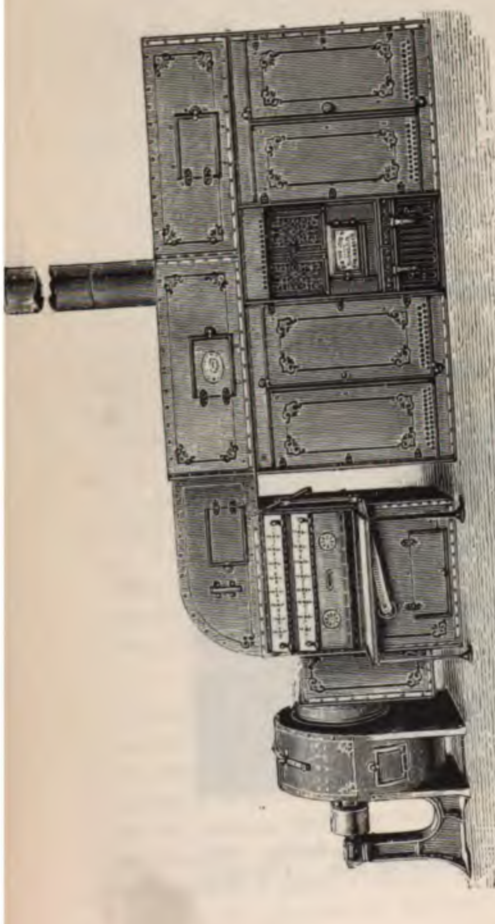


FIG. 2. DOWNDRAFT DRYING MACHINE.

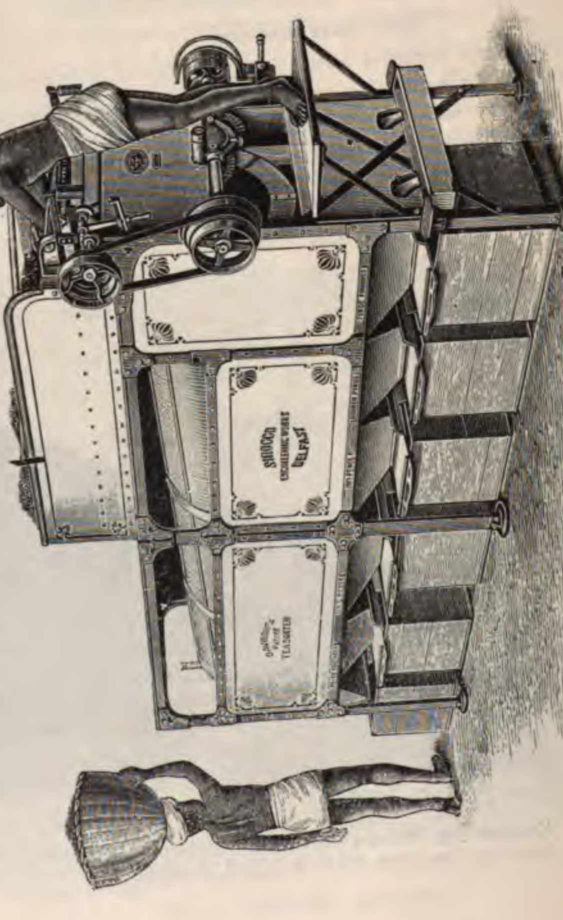


FIG. 4. TEA SORTING MACHINE.

in fig. 2), the hot air which is produced in the stove is drawn down through the trays, on which is spread the wet roll, by means of a "Sirocco" centrifugal fan. The trays in the drying chamber, which are operated by a coolie, are inserted through the bottom tray port and gradually raised by a system of levers until they come opposite the top tray port, when they are withdrawn, the tea being then fully dried.

The "Updraft" Sirocco Drying Machine (fig. 3), as the name implies, works with a self-acting upward current of heated air, and does not require any mechanical power. As will be clear from the accompanying illustration, the chamber containing the trays is above the stove, so that the upward current of heated air passes through the leaf spread on the trays. Afterwards, it passes either into the factory, or up the chimney, as desired. These machines are made in two types, in one of which the trays are inserted at one end of the machine, and in the other at the side of the machine.

We are informed by Messrs. Davidson and Co., Ltd., that they have just shipped to India the first of a new and improved form of drying machine of the automatic type, designed to deal with 350 lb. of fully dried tea per hour. Only one attendant will be necessary to feed the leaf into this machine, and it will be automatically discharged when the drying process is completed. The power required for driving the necessary gearing has been reduced to a minimum, and special attention has been given to strength, simplicity of construction, efficiency, and economy in working.

Any class of fuel may be used in the stoves with these driers, and a special attachment has recently been perfected for the application of oil fuel, which will be of special interest to planters in districts where wood is becoming scarce.

SORTING AND GRADING.

Mechanical appliances are also provided for the sorting or grading of the tea (fig. 4) when dried, into various qualities, and also a machine for packing it into chests. We understand that the latter operation, until a recent period, was effected by coolies tramping the tea into chests with their bare feet, and though we have not seen this operation performed, we should distinctly prefer Messrs. Davidson's Mechanical Packer. The machine has a vibrating table on which the chests are clamped, and to which is imparted about 2,000 vibrations per minute. This vibrating motion causes all the particles of tea to settle down closely in the chest, which is thus filled compactly and uniformly, 110 lb. chest of tea taking about two minutes to pack. Fig. 5 is an illustration of this interesting machine.

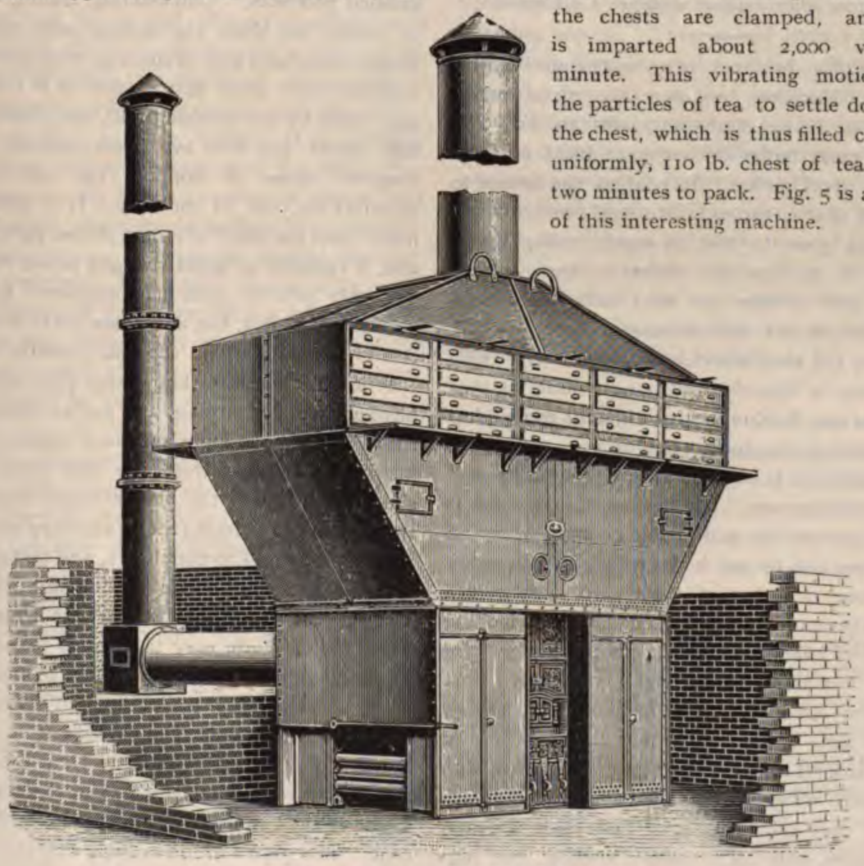


FIG. 3. UPDRAFT DRYING MACHINE.

IRON AND STEEL NOTES.

(Continued from page 193.)

I NOW conclude the extracts from the useful paper which Mr. Jos. H. Harrison read before the Cleveland Institution of Engineers. With regard to blowing engines, Mr. Harrison thinks Cleveland can claim to be a pioneer in this country, both in gas-blowing engines and turbo-blowing engines, but we follow painfully slowly. Both these are successful. The former, including its auxiliaries, takes more looking after than the usual steam reciprocating engine, but it uses only about one-third the gas. The turbo blower requires no less steam, but takes much less attention and oil, and gives no pulsations of blast. Both these innovations are distinctly improvements, and will be rapidly taken advantage of. Pyrometers are now becoming very common about blast furnaces, but there are still many who do not see the value of them. A furnace run without a pyrometer is very much like a ship sailing without a compass.

Leaving the blast furnaces, to go to the steel works, continues Mr. Harrison, we pass the metal mixer on the way, or if we don't we ought to do. The mixer is the great buffer between the blast furnaceman and the steel maker. It enables the former to get a good lot of iron through into steel, which would have otherwise gone to rust in stock, owing to its quality, and it enables the latter to know pretty nearly what sort of iron the next ladle will bring. Both these reduce cost, and increase output.

On reaching the steel works, possibly the first thing that strikes one is that the mill is not rolling at that moment—this may be due to fifty different causes, but it is most likely to be due to one of two—either the steel is not ready for it, or the finished product has not been got out of the way. The author thinks there is not a single steel works mill in this country where an average of from one to two hours is not lost on every shift, from one or other of these two causes. He considers this is one of the most telling factors in looking for the cause of falling behind our competitors in steel production. He thinks that those who have just returned from America will back him up by saying they saw no time lost on mills over there. The mill is the hub, around which everything must turn, and it is our failure to appreciate this that allows things to go on as they do. You may have half a dozen melting furnaces, with all necessary heating, and cogging appliances to prepare the raw material, but you have only one mill. That mill measures the work done, and it must be kept going all the time at full speed, if the plant as a whole is to make profits. Every single operation, both before and after it, must not only be able to keep step with it, but must have a bit up its sleeve, to meet an extra spurt of the mill when it has an easy order on. If the furnaces cannot make steel enough for the mill, and you are quite sure nothing is holding them back, put down more furnaces. Far better spend money this way and get a return, than to have men and machinery eating their heads off. Every one of them has got to earn a profit, and if you don't give them enough employment, how can they?

As a rule, the ingots here are not given time enough in the furnace. This is due largely to a deficiency of furnaces, and it results in very excessive rejections of finished products. Quick-acting cranes, or machines, to charge and draw the ingots, with rapid means for lifting doors, and men trained to keep the cogging mill supplied with steel just as fast as it can be finished and taken by the finishing mill, are points to be carefully noted, and seen to. Then, looking at the other frequent cause of stopping the mill—the finished material not out of the way. If a mill can roll so many tons per shift, whether plates, rails, or anything else, it requires no great thought to see that you must not only provide sufficient machines to finish that quantity per shift, but also room for it to cool, and yet this is the point where the delay mostly occurs.

It is quite common knowledge that our competitors have a much better plan, and yet we make no effort to follow it. By putting a sufficient length of light, slow-moving roller gear from the mill roller gear to the shears, and letting the plates simply crawl along this, the air can get allround them, and they will be cooled by the time they get to the shears, and be far less buckled than at present, besides costing nothing for labour. If sufficient ground length is not available on the straight it is quite easy to arrange roller gear side by side, and skid the plates from one to the other at the ends, so that they travel up and down and finally arrive at the shears. The plates can be inspected and marked as they crawl along. They are kept orderly and travel with regularity out of the way of the mill which is thus enabled to increase its output by 50 per cent. The plates are thus kept well above the ground level, where they get plenty of fresh air, and there is a chance keeping the roller gear under supervision. There is also no unequal cooling to cause excessive buckling.

Going further into the buckling question, Mr. Harrison asks why the buckles are not taken out before the plates leave the works? When a buyer orders plates he expects to get flat ones, but he never does in this country. Wherever one goes into a bridge, boiler or other shop where plates are being used, we find men laboriously flattening those delivered, either by hammers or flat blocks or by passing them through a series of rollers. It is not only the platemaker's business to flatten his plates and finish the job, but he can do it far more easily and cheaply than anyone else by passing them through a series of rollers before they are cold as they are crawling down from the mill to the shears. Our American friends do it regularly, and why should not we? One machine would do the work of ten in the buyers' shops, and would do less harm to the plate.

If the product is rails or other sections, greater hot bank room is required than is found at most mills, so that the bars can lie to cool without touching each other, having air all round them with a view to reducing the straightening to a minimum. This straightening is a very serious business indeed with us. There is far too much of it at many works. It is not only expensive, but it checks the output of the mill. Provided the ingot or the bloom is properly heated, and the rolls are right, there should be very little straightening required if care is taken in cooling the bar. A rail is symmetrical in section, and a little judgment in cambering it should produce a fairly straight bar. At any rate, there is no excuse for some of the snakes one sees waiting to be straightened, and some intelligence should be used to stop it.

Open-hearth furnaces have made rapid strides in recent years, both in capacity of furnaces and output. Mechanical charging machines are not yet generally used. They not only save hard manual labour, but charge the material in a fraction of the time, so that the furnace doors are not letting cold air in to anything like the same extent. The machine can do the work at a fraction of the cost, so that wages can be saved, and the machine takes no note of hot days.

The tilting form of furnace is an expensive one, but it does away with all tapping hole troubles, and for the Talbot process it is ideal. This process is satisfactory at Frodingham, and a second furnace is being erected there, so that there is no further reason to hesitate in adopting it here. It is true, three of these furnaces are now being erected at one works here, but other firms do not follow readily. The old-fashioned system of casting ingots from the open-hearth furnace in a pit still exists, even though the ladle is handled by an overhead crane. When the crane has got to carry the metal along, it is quite an easy matter to lift it first high enough to clear the moulds, set on bogies, running on a railway on ground level. This saves all the mess in the pit, enables the steel to go straight to the stripper crane, and the ingots are in the heating furnace with far less trouble, expense, and loss of tme.

The charging and drawing of the ingots and slabs should be no longer a job for half a dozen men. With the machines now well known, it is only a one man job with a boy to lift the doors, and he is far more reliable than the half dozen to keep step with the mill's requirements. He has no one to blame for any delay, and he puts the piece in the right place every time. With regard to the speed of rolling rails and bars, the pieces don't follow up quickly enough. There is no need for the roughers to be simply spectators of the finishing process. They should have a piece in all the time, both roughing and finishing. It is a fact that in America they have to hold back seven or eight rails until they are cool enough for the finishing pass. There is no such trouble here. Probably some of this excess of heat is due to better heating, but the quicker following-up has much to do with it. In cropping the ends off blooms and slabs, it is a crude method to lift each crop end with dogs and a crane. Why not run a bogie under, and shoot the crop ends down into it? If a railway can't be got in, shoot them down into a box, and let one lift do for a boxful.

It has been truly said it is waste of time and money to simply copy literally American plant and methods because their conditions and ours are widely different. But there is very little difficulty in selecting from their stock of these articles such as are suitable for our conditions and adopting others to make them so.

The American aims to make large outputs and sometimes pays poor dividends. With us, the first aim is to pay dividends, and no credit is given for record outputs if the dividend is reduced. This makes a world of difference. Mr. Harrison is of opinion that Americans overstep the mark in their eagerness for "record makes." He opines that there is a middle course between their practice and ours, which if properly managed will give "record profits."

BRITISH COAL.

POSSIBLE ECONOMIES IN PRODUCTION AND USE

IN our last issue we called attention to the estimated amount of coal in the British Isles, and some other salient features of the valuable and suggestive report of the Royal Commission on Coal Supply. As regards the available coal the report is a distinctly cheerful document. We have often been assured that the use of coal will become obsolete within a measurable distance of time, and this has been put forward as an answer to those who view with alarm our exports of steam coal. In any event it appears that there is a very wide margin available, for we have enough coal to last from 400 to 600 years. The most suggestive and valuable part of the report is that which deals with possible economies; (1) underground, (2) in the preparation of coal for the market, (3) in transport from the collieries, and (4) in use.

THE TENTATIVE NATURE OF COAL STATISTICS.

As regards the total estimate of available coal we welcome the figures given for their magnitude, but how tentative such compilations are, is illustrated by the fact that although between January 1st, 1870, and December 31st, 1903, 5,694,928,507 tons of coal have been raised, the present estimates of available coal are nevertheless 10,707,382,769 tons in excess of those of the previous Commission. This excess is accounted for, partly by the difference in the areas regarded as productive by the two Commissions, and partly by discoveries due to recent borings, sinkings, and workings, and more accurate knowledge of the coal seams.

The calculations of the Commission as to the available resources are based for the most part upon the assumption that present conditions will continue, but they are fully alive to the possibility that improved methods and appliances will result in the getting of a greater percentage of coal than that which they have estimated to be available.

As already explained the Commission regard 4,000 ft. as the limit of practical working; at the same time they point out that it is difficult to determine the maximum temperature which is consistent with the healthful exercise of human labour. There seems, however, to be no difficulty in working at upwards of ninety degrees provided the ventilation is brisk and the air dry. Experts on the Continent, notably Professor Stassart and Herr Schultz-Briesen, consider 1,500 metres, or say 4,900 ft., about the limit of working.

PROBABLE DURATION OF OUR COAL RESOURCES.

This question, the Commissioners point out, turns chiefly upon the maintenance or the variation of the annual output. The calculations of the last Coal Commission as to the future exports and of Mr. Jevons as to the future annual consumption make them hesitate to prophesy how long our coal resources are likely to last. The present annual output is in round numbers 230 million tons, and the calculated available resources in the proved coalfields are in round numbers 100,000 million tons, exclusive of the 40,000 million tons in the unproved coalfields, which they have thought best to regard only as probable or speculative. For the last 30 years the average increase in the output has been 2½ per cent. per annum—and that of the exports (including bunkers) 4½ per cent. per annum. It is the general opinion of the District Commissioners that, owing to physical considerations, it is highly improbable that the present rate of increase of the output of coal can long continue—indeed, they think that some districts have already attained their maximum output; but that on the other hand the developments in the newer coalfields will probably increase the total output for some years. In view of this opinion and of the exhaustion of the shallower collieries they look forward to a time, not far distant, when the rate of increase of output will be slower, to be followed by a period of stationary output, and then a gradual decline.

COAL-CUTTING MACHINES.

Coming to underground economies, almost all the opinions given on the general question of coal-cutting machines compared with hand labour were, as already stated, in favour of the former; but these opinions were accompanied by many qualifications and exceptions, and it is apparent to the Commissioners that the balance of advantage and disadvantage depends to a large extent upon the circumstances of each pit, and sometimes of the different districts in the same pit. The choice of machine also depends on these circumstances. There seems to be no doubt that coal-cutting machines are now firmly established.

The chief advantages of coal-cutting machines, according to the evidence, are set forth as follows:—(1) That an increased percentage of large coal is obtained, and the coal got is in a firmer and better condition. (2) A more regular line of face is obtained, which facilitates ventilation and leads to more regular and systematic timbering, and the weight being more regular and uniform the roof can be more easily kept up. The greater rapidity of working also tends to keep down the cost of repairs, and causes less damage to overlying seams and the surface, the subsidence being more even. (3) The regular and systematic working tends to increase the safety of the workmen. (4) Seams, which either because of their thinness or hardness, or both, could not be worked at all, or could only be worked at a profit in good times, can be worked profitably by machines. (5) Holing is less frequently done in the coal and, when it is, there is much less "small" made than in the case of holing by hand. (6) The output is increased, and is more regular, and the work is more easily superintended. Fewer explosives are used for getting down the coal; in some cases none. Generally machine work is less costly than hand work, especially in thin seams. According to one witness the saving is much greater in the narrow work or headings than in the longwall faces. From the point of view of the men the work is safer and easier, and the wages are better. The importance of lightening the labour of the men will probably be more appreciated as the working places become deeper and the temperature becomes higher.

There are, however, certain conditions under which machines cannot at present be worked to advantage, viz., where the roof or floor is bad, where there are numerous faults or dykes or where the seams are highly inclined. So, too, in the case of very soft coal there is the danger of falls from the face and damage to the machines.

EXPLOSIVES AND SUBSTITUTES.

Although the general effect of the extended use of coal-cutting machines has apparently been to reduce the use of explosives, it appears that in some cases shot firing has increased for breaking up the larger blocks brought down. For many years attempts have been made to devise some sort of appliance which would get rid of this source of danger. Lime cartridges and patent wedges have been tried, but hitherto without much success. It is claimed that the hydraulic cartridge or wedge, which is now used in at least one colliery in Lancashire, has enabled shot firing to be dispensed with altogether, and has at the same time given a greater percentage of large coal.

ELECTRICITY AND COMPRESSED AIR.

At a modern colliery, and especially since the introduction of coal-cutting machines on a large scale, the use of electricity for the transmission of power is according to the evidence, invaluable both from the point of view of economy and efficiency. It is said to be well adapted for every requirement of mining and for all the general purposes of a colliery, with the possible exception of the winding engines, the opinion in this country being at present against using electrical winding engines, although some are being used on the Continent.

In connection with the preparation of coal for the market the Commission strongly emphasise the great advantages obtainable from improved machinery for the better handling, the avoidance of breakage, etc. Not only is the value of the product thereby greatly enhanced, but much small coal formerly unsaleable at a profit and, therefore, not worth bringing to the surface, is now brought out and sold to advantage after washing. Such careful preparation of the output has not, however, found universal application in this country. It is said that we do not lay ourselves out to suit the requirements of our customers, either at home or abroad, and that as regards foreign markets the methods of our Continental competitors, especially Germany, are more scientific and more satisfactory. They strongly urge the importance of cleaning, sizing, and sorting coal for the market. The more the consumers realise the advantages that accrue from the use of coal selected to suit their special requirements and appliances, the more will they expect and demand uniformity of quality and size. Uniformity is important, a consumer willingly paying more, if he can rely upon always getting what his experience has proved to be best suited for his purposes.

(To be continued.)

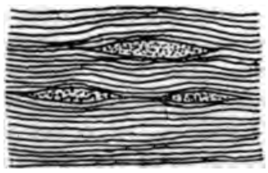
MICA MINING IN SOUTHERN INDIA.

A paper on this subject was read before the last meeting of the Institution of Mining and Metallurgy, by Mr. George A. Stonier, of which the following is an abstract:—

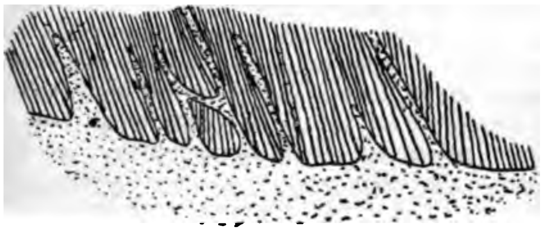
Mica mining in India is of importance in only two areas, Koderma and Nellore. This paper deals with the latter district. The area over which payable mica has been found in Nellore measures 114 miles by 48. It consists of a series of well-foliated garnetiferous, talcose, chlorite, biotite, hornblende, kyanite, and staurolite schists, quartzites and gneisses of older palæozoic age, and is penetrated by a number of sheets, dykes, and small bosses of pegmatite.

The payable " books " of muscovite are at, or close to, the junction of the pegmatites with the biotite and hornblende schists, but are never found in the latter.

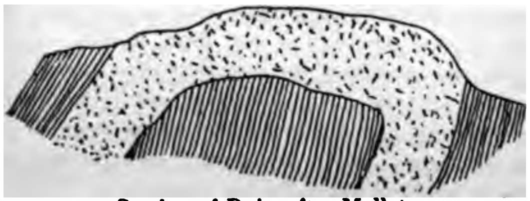
The plan of working is to quarry at the junction of the pegmatite and schist, and as the dip of the junction is high, quarrying can be continued to a great depth. Very little underground mining has been attempted. Kodalis are used to excavate the soft earth, but to quarry to pegmatite men work in pairs, and use 10-lb. hammers with 15-inch handles, and small wedges. Boring holes for blasting is done with hand-driven 1 in. octagonal drills, 18 in. to 4 ft. in length. Eight feet of drilling per day in quartz, and 12 to 14 ft. in felspar, is considered a day's task: the deepest hole is 4 ft. The mica is prepared for market by splitting up into flat pieces not more than $\frac{1}{8}$ in. in thickness, free from flaws, and cracks, and without cross graining. They are finally cut into rectangles, tied into bundles, and packed in mango wood boxes. Only 10 to 15 per cent. of the mica mined reaches the market.



Lenticular Pockets of Pegmatite after Mallet.



Plan of Dyke after Mallet.



Section of Dyke after Mallet.

MULTIPLE EFFECT EVAPORATION.

A paper under this title was read before the Manchester Association of Engineers on Saturday last by Mr. Charles Day. The following is an abstract:—

In dealing with the concentration of certain liquors, it is desirable that the highest density should be accompanied by the highest temperature, as owing to the increased fluidity at higher temperatures the concentration can then sometimes be carried to a greater degree. Under such circumstances the liquor instead of entering the first vessel and finishing at the third in the usual way, may have its passage through the machine reversed; this, however, necessitates pumps to convey it from vessel to vessel owing to the pressure rising in the direction of the flow instead of falling.

AN IMPORTANT FEATURE IN DESIGN.

In the design of evaporators of the type under consideration, one important point is the rate of heat transmission through metallic surfaces. This is a subject which, though much experimented upon, is still very vague, and is one worthy of further investigation. The experiments which have been made with surface condensers and with evaporator tubes of various diameters have given very contradictory results. Newton's law that the transmission of heat is directly proportional to the difference of temperature in no longer accepted as true. The most complete series of experiments of which the writer has information are those of Mr. G. A. Hagemann, of Copenhagen. An extract of these can be found in the " Proceedings of the Institution of Civil Engineers," Vol. 77. These experiments included determinations of the rate of heat transmission through brass tubes for different ranges of temperature and for different rates of flow of liquor through the tubes, steam being on the outside of the tubes. The experiments were made with vertical tubes and may not apply equally to horizontal ones.

THE EFFECT OF TEMPERATURE.

Experiments show that there is an increase in the rate of evaporation per square foot by rapid circulation of the liquid in the tube, and doubtless this applies not only to evaporators and condensers, but also to boilers.

Figs. 1 and 2 show that the rate of transmission per degree of temperature difference is greatest when the temperature difference ranges from 15 deg. F. with a low speed of flow to 40 deg. when the speed of flow is 5·4 ft. per second. The curve F shows the results obtained when the water in the tube was boiling, the rate of flow being only that arising from the disturbance due to ebulition. When compared with the results obtained at low rates of flow (see curve B) it will be seen that the rate of transmission is much higher when heat is transmitted to a boiling liquid than to one not boiling. Other experimenters have found that the heat transmission per square foot is three to four times as rapid when the liquid is boiling than when otherwise, which fact may explain the greatly improved output from boilers when very hot feed-water is supplied to them. Possibly the advantage of live steam feed-heaters on board ship may be largely due to this cause.

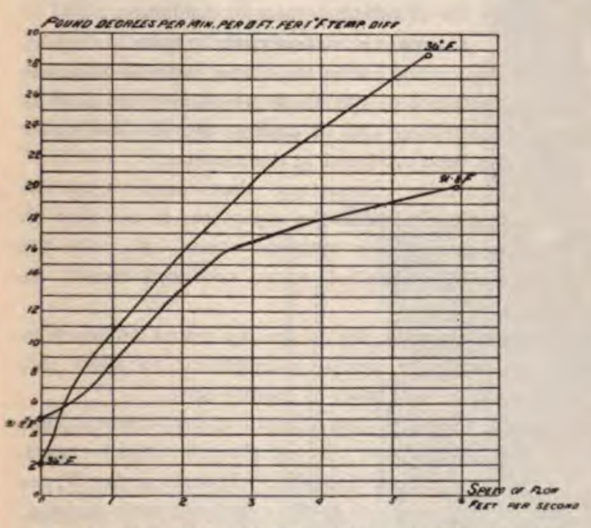


FIG. 1. DIAGRAM SHOWING TRANSMISSION OF HEAT WITH A CONSTANT "TEMPERATURE DIFFERENCE" AND A VARYING SPEED OF FLOW.

SIX-EFFECT YARYAN EVAPORATOR.

Fig. 3, is a diagrammatic drawing of a six-effect Yaryan evaporator, and from it the course of the liquor to be evaporated, and of the steam causing the evaporation can readily be traced. When used for the distillation of water the impure water is drawn from the circulating water which has passed through the condenser and which has thus been somewhat heated. It is then pumped through the first heater then forward through the second heater, whence it passes through heating tubes, shown dotted on diagram in each of the six evaporating vessels or effects.

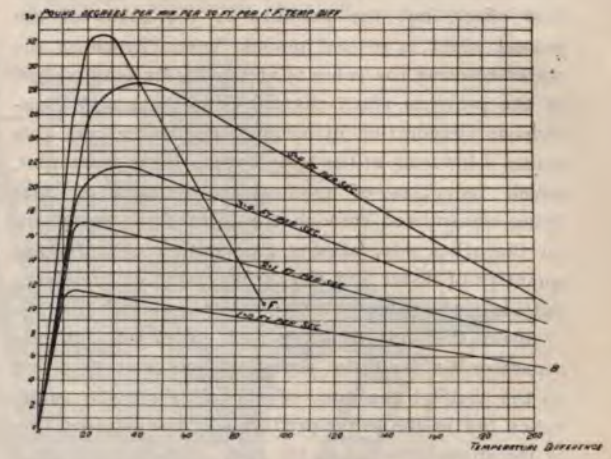


FIG. 2. DIAGRAM SHOWING TRANSMISSION OF HEAT WITH A VARYING "TEMPERATURE DIFFERENCE" AND A CONSTANT SPEED OF FLOW.

By the time it has passed through the last set of heating tubes, which is contained in the first or high temperature effect or vessel, its temperature will not be much below the temperature of the steam supplied to that effect. At this point, or if preferred at any earlier point, it may be taken to a specially constructed lime catcher, shown on top of separator column, containing a steam coil which brings the water to that temperature at which most of the lime and similar salts are readily precipitated; suitable re-agents may be added to assist precipitation. Before leaving this lime catcher the water is filtered; it then passes to the evaporating tubes of the first effect. The shell of this vessel or effect receives steam from the boiler at a pressure of about 40 lb. per square inch. In many cases a higher pressure and a greater number of effects may be adopted where the liquor is such that treatment at a high temperature is not likely to be injurious, but machines are seldom made with more than six effects.

SIX-EFFECT EVAPORATOR.

The water formed by the condensation of steam supplied to the first effect is usually returned direct to the boiler, thus the boiler is fed with pure distilled water at a high temperature, consequently a high evaporation per pound of coal should result and be well maintained. The steam formed in the tubes of the first effect, together with the water, pass to the separator S1, where the steam separates from the water and is led to the shell of the second effect, whilst the water passes into the tubes of this effect. The pressure in the shell of this effect practically corresponds with the pressure in the tubes of the first effect, but the pressure in the tubes of the second effect is several pounds lower, hence as the water entering the tubes is at the higher temperature of the previous effect there is immediate and spontaneous evaporation of some of the water, and this causes a lowering of the temperature of the remainder, which reduction of temperature permits of heat being transmitted through the tubes from the steam on the other side, causing evaporation of a further quantity of water and the condensation of the steam outside of the tubes.

Again the mixed water and steam pass to the separator S2, and the separated steam is then led to the shell of the next effect, and the water to its tubes, but as the water produced by the condensation of the steam supplied to the shell of the second effect is not wanted for boiler feeding, it is drained into the shell of the third effect as shown, and there imparts some of its heat to the water in the tubes. Spontaneous evaporation also takes place here, owing to the water entering a vessel in which the boiling temperature of water is lower than the temperature of the incoming water.

This cycle of operations is repeated in succeeding effects until the last one is reached, which, in the example chosen, is the sixth effect. From here the water drained from the second, third, fourth, and fifth effects, together with the water of condensation formed on its own tubes, is drained to the second heater, whence it passes to the condenser. The steam from the last separator, S6, passes at this stage to the first heater where some of it is condensed, the final condensation taking place in the surface condenser shown, where not only does this condensation take place, but the water so formed is, along with the water drawn from the previous shells, finally cooled by the circulating water in condenser.

A VITALLY IMPORTANT POINT.

This final action serves the double purpose of raising the temperature of the water which is to be used to feed the machine and of cooling the distilled water which has been produced in the machine.

It is vitally important that great care be taken in the design of the separators to see that no water is carried over with the steam, otherwise the purity of the distilled water produced would be vitiated.

In the diagram, fig. 3, the top vessel is shown in section, and the special arrangement to allow free expansion of the tubes is readily seen.

It will be noticed that this form of evapofator secruse the high rate of flow through the tubes which experiments show to be so desirable. Though 31 deg. F. per effect would appear to be the most favourable division, experience has shown that a rather larger temperature difference is advantageous in the last, or last two effects. Fig. 4 shows the general appearance of a Mirrlees Watson six-effect evaporator.

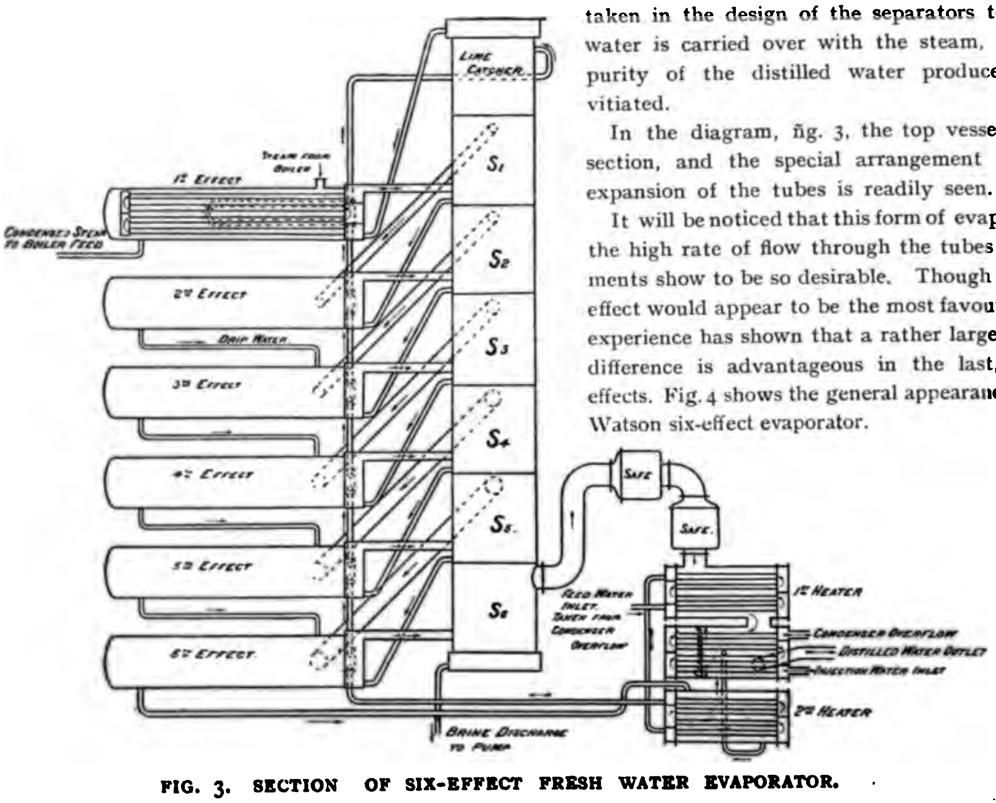


FIG. 3. SECTION OF SIX-EFFECT FRESH WATER EVAPORATOR.

SILK SPINNING MACHINERY.

At a meeting of the Leeds Association of Engineers, held on January 26th, the vice-president (Mr. W. H. Drake) occupying the chair, Mr. R. W. Crabtree delivered a lecture on Silk Spinning Machinery. In reality, said the lecturer, silk was spun by the insect, the use of machinery being for combing, dressing, twisting, etc. As a cocoon consisted of a single fibre gradually becoming thinner throughout its length, in twisting much skill was requisite in constantly adding to the six or seven strands commenced with to keep the thread equal. Mr. Crabtree exhibited a reel and spindle which did the twisting and winding at one operation at a speed of 10,000 revolutions per minute, and only required oiling once a month. Among other machines shown was a patent faller, much cheaper and thrice as strong as an ordinary faller.

At the Society of Arts on Wednesday last, Sir William H. Preece, F.R.S., read a paper on the "Navigation of the Nile." He said that the works required to improve the navigation of the Nile were the removal of obstructive banks and shoals, the building of quays, the abolition of Shadufs and Sakias, the construction of training walls, and the development of new lands by the deposit of the silt. Thirty thousand tons of valuable mud were lost in the sea every year.

The Junior Institution of Engineers will hold its "coming of age" dinner at the Hotel Cecil on Saturday, February 11th. The president, Mr. W. H. Lindley, M.Inst.C.E., will occupy the chair.

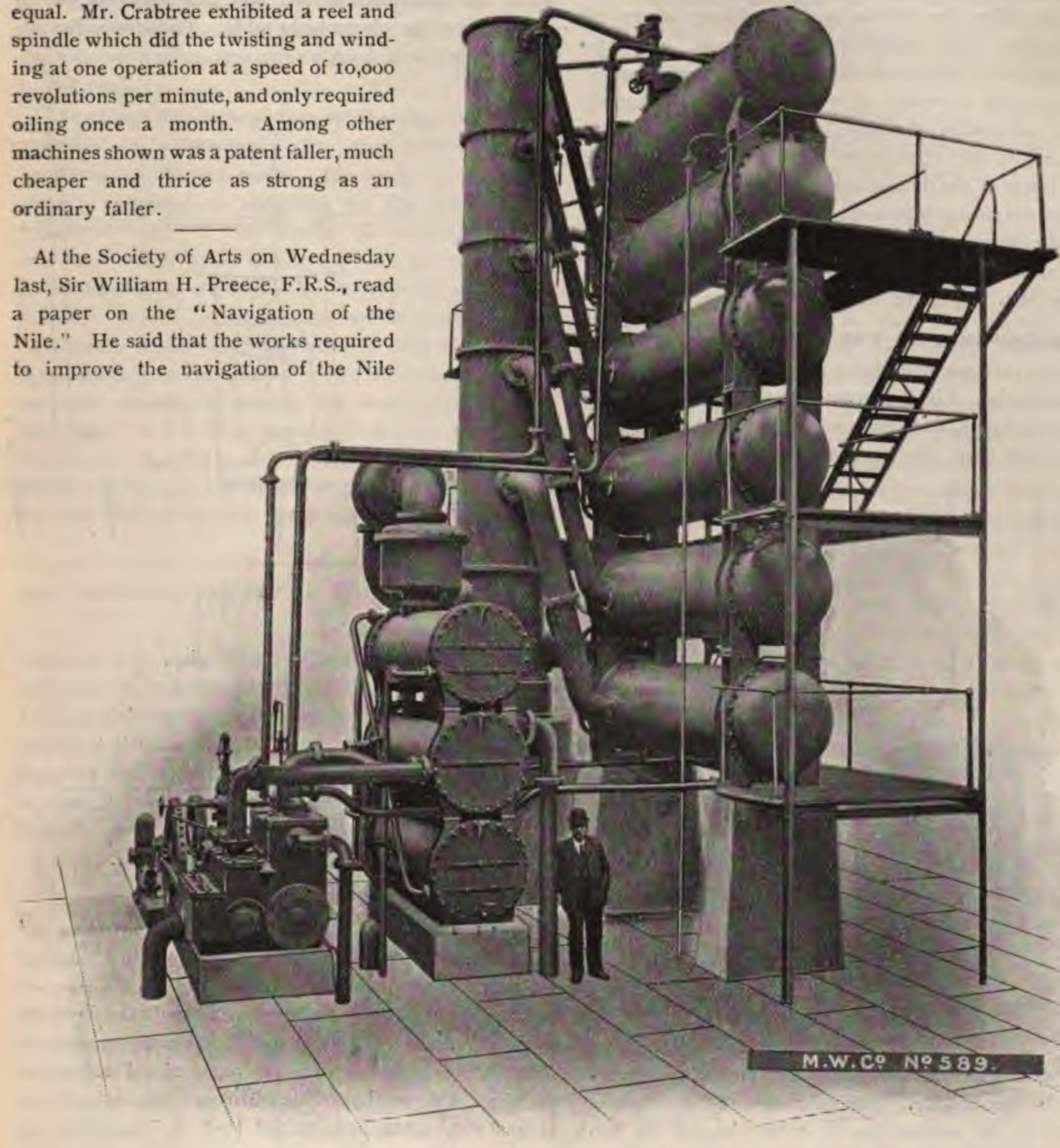


FIG. 4 SIX-EFFECT EVAPORATOR BY MESSRS. MIRRLEES, WATSON AND CO., LTD.

MASS ANALYSES OF MUNTZ'S METAL

A paper on this subject was read before the Faraday Society on Monday last, by Mr. John G. A Rhodin The following is an abstract of the paper :—

Towards the end of 1903 the author was asked by the Muntz's Metal Company, Ltd., to devise a method of accurately determining the copper contents of Muntz's metal at such a speed as to enable the management to utilise the results in the ordinary course of manufacture. The difficulties were many, viz, the large number of analyses required, the extreme accuracy necessary, the necessity of working during the night as well as during the day, and finally the *conditio sine qua non* that the results must be obtained within twelve hours of the time of casting. The author decided to adopt the electrolytic method, and having to deal with unusual current densities, decided to increase both the anode and cathode surfaces to the utmost limit compatible with moderate weight.

DESCRIPTION OF THE APPARATUS USED.

For this reason a fine platinum wire gauze was chosen as the material. Fig. 1 represents a pair of electrodes, *a* being the cathode, and *b* the anode. The anode, however, differs from most constructions by having a cylindrical part of extensive surface, which, when in use, is concentric with the cathode. The pole wire of the anode is fastened to the bottom ring at *c*. By having the two points of maximum P.D. at the upper and at the lower end of each of two concentric electrodes, it may be assumed that the current distribution will be very even, as when such an arrangement is used, the P. D. between any two radically opposed points in any horizontal section is, theoretically and practically, everywhere the same. Secondly, the arrangement offers no obstacle to the rapid removal of the cathode. Fig. 2 shows a couple of these electrodes in use.

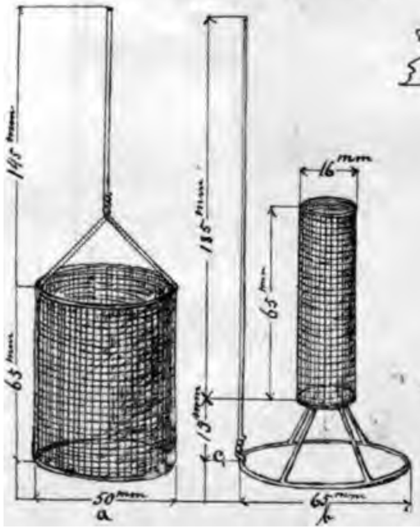


FIG. 1. PAIR OF ELECTRODES.

The process is the simplest one possible. One gramme of the alloy is dissolved in 20 c.c. nitric acid, 1·2 sp.g., and the solution is heated on a sand bath till the red fumes disappear ; 300 c.c. of distilled water are afterwards added, and the beaker is put in its place on the electrolytic table. The electrodes are put in, and electrolysis is proceeded with. Two current densities are employed, viz., 0·5 amperes or 2·0 amperes With the low current-density all the copper is deposited after twelve to fifteen hours and eventually it is cooled in the open air and weighed. With the high current-density, the time necessary for complete deposition of the copper is only three hours, and the deposit obtained is perfectly adherent to the cathode.

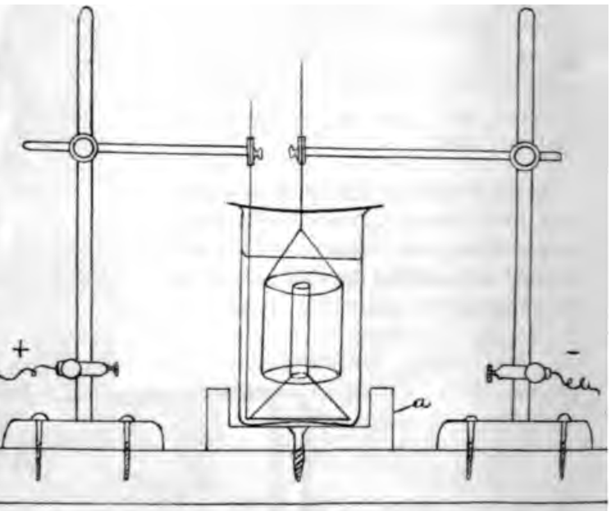


FIG. 2. SHOWING TWO OF THE ELECTRODES IN USE.

PHASES OF THE REACTION.

That the copper is fully deposited is patent from the the fact that the remaining solution gives no reaction for copper with any known re-agent. As a matter of fact one may distinguish between three distinct phases of the reaction : (1) Copper deposition and ammoniacal reduction of nitric acid ; (2) ammoniacal reduction *per se* ; (3) deposition of zinc in some form or another. It has very often been stated that the deposition of copper in the presence of zinc is incomplete, and many theoretical considerations would lend support to this statement. The author thinks, however that in the case under consideration, where the overlapping phase 2 occupies a long time, and is unaccompanied by metal deposition, a perfect separation is theoretically possible. Differences due to inherent analytical errors, and those arising from a possible lack of uniformity in the metal are extremely small. The practical utility of the analyses have led to greater accuracy in manufacture, the metal which has to be remelted being less than 2 per cent. of the whole, since the analytical control was established. The point is worth referring to in connection with the modern problem of manufacturing economy. Fig. 1 shows the main installation of twenty-five pairs, and gives a good idea of the exterior of the plant.

The author foreshadows the probable issue of a further research in connection with the electro-chemical properties of Muntz's metal. The metal is, to a great extent, employed as sheathing for the protection of woodwork against the action of certain mollusca and algæ which breed in the sea. To be successful it must dissolve in sea water by electrolytic action to a sufficient extent to render the surface poisonous, but sufficiently slowly to make its use economical. The optimum must occur when the two constituents, copper and zinc, dissolve at exactly the same rates in which they occur in the alloy, during as great a part of the life of the plate as possible. By this means only the metal will remain of similar composition throughout its life, or the greater part thereof. That such a state of equilibrium is possible in the case of an alloy is in itself very interesting, and promises a future development of a very important nature, viz., an elucidation of the molecular work in alloys, and its subdivision in component parts. A further communication on this interesting subject is promised by the author.

HYDRAULIC PRESSING, STAMPING AND FORGING MACHINERY.

A paper on this subject was read before the Liverpool Engineering Society by Mr. F. W. Steele on the 25th January.

The designing of an hydraulic press with its complete plant is a matter requiring careful consideration, especially in an installation running into thousands of pounds.

It is essential that the installation should be so designed that the work to be done should be produced at a minimum of labour and cost. Every part should be carefully considered so that the pattern-maker, moulder, smith, machinist and erector should have the minimum of labour in constructing it. Complicated brackets, difficult forgings and machining is very often the cause of enhanced cost of production of the plant. An important point is to see that the material used is distributed to the best advantage; the breaking strain of the material being known, the experienced designer knows the safe limit of stress to allow.

This very much depends upon the nature of the machine, that is to say, whether it is slow working or quick working of the column type or open gap type. For instance, in an ordinary four column press, with tables of cast iron, 1¼ tons per square inch stress may be allowed in tension and 2 tons per square inch in compression, with the material to stand the usual test. In a gap machine such a stress would be much lower in tension and compression. In cast steel the stress is much greater, the tension and compression being the same, 5 tons per square inch for tension and compression in a column machine, and 3½ tons per square inch for open gap machines. It is not advisable to take these figures for all circumstances, as conditions vary with centres of columns and

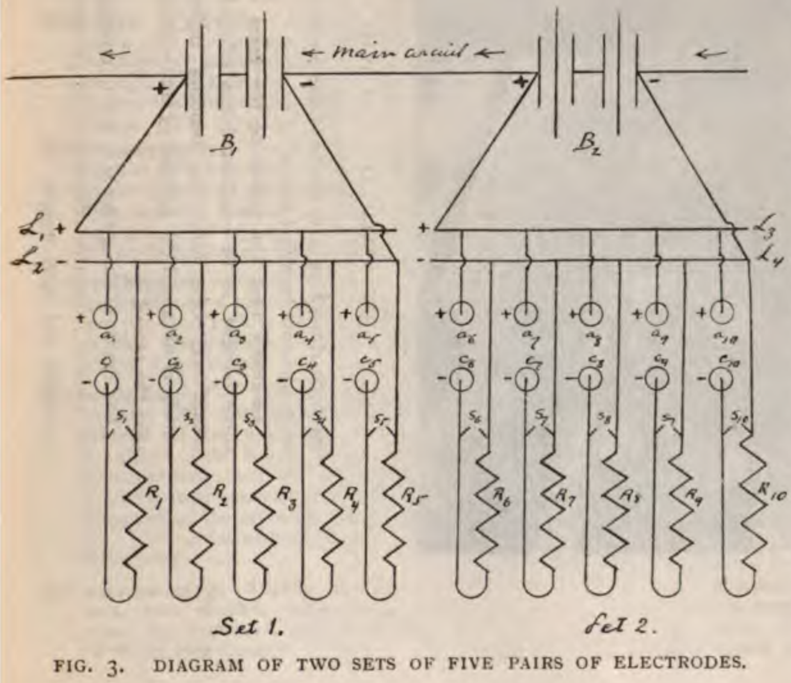

← main circuit ←
←
←
+
-
B_1
B_2
L_1 +
L_2 -
L_3
L_4
a_1 a_2 a_3 a_4 a_5 a_6 a_7 a_8 a_9 a_{10}
c_1 c_2 c_3 c_4 c_5 c_6 c_7 c_8 c_9 c_{10}
S_1 S_2 S_3 S_4 S_5 S_6 S_7 S_8 S_9 S_{10}
R_1 R_2 R_3 R_4 R_5 R_6 R_7 R_8 R_9 R_{10}
Set 1.
Set 2.

FIG. 3. DIAGRAM OF TWO SETS OF FIVE PAIRS OF ELECTRODES.

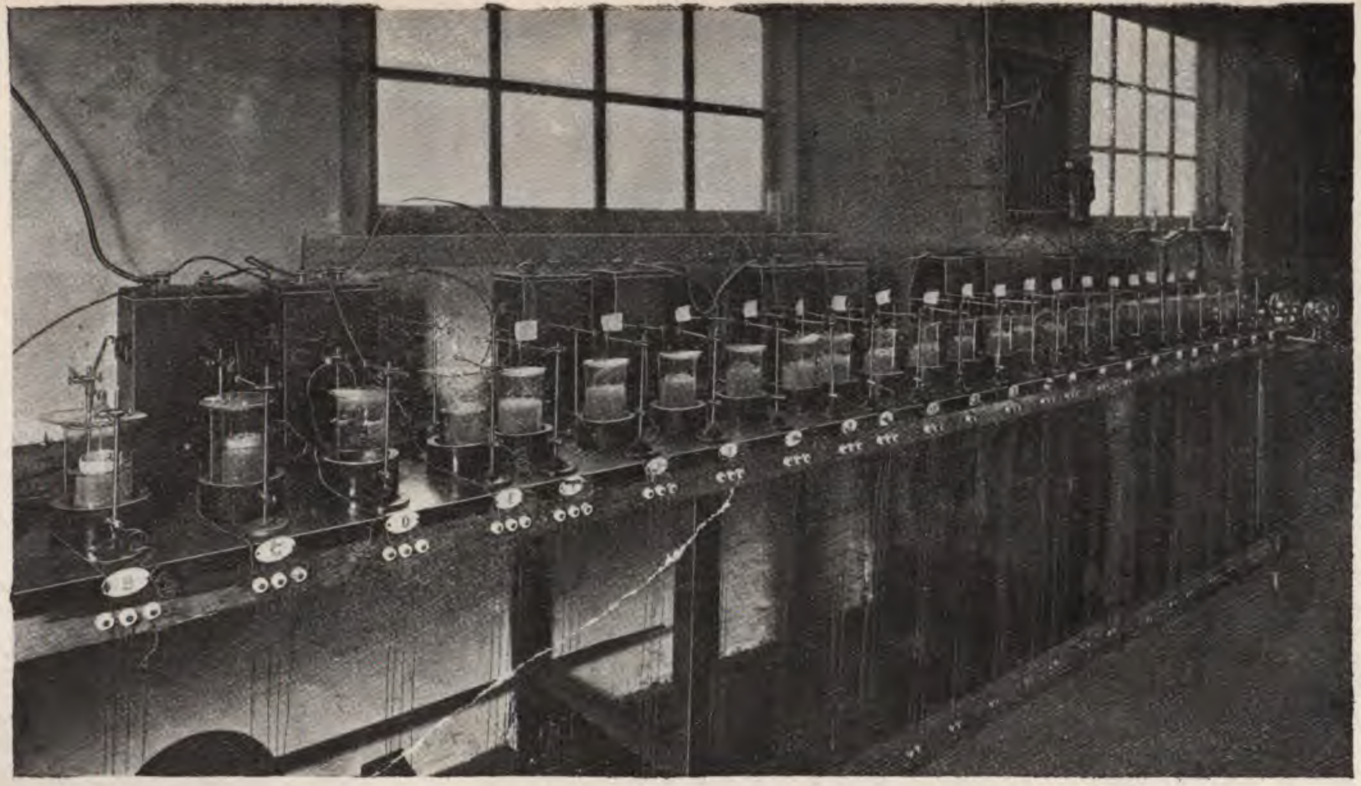


FIG. 4. MAIN INSTALLATION OF PAIRS OF ELECTRODES USED IN MASS ANALYSES OF MUNTZ'S METAL.

methods of working, also steel by different makers varies in its ultimate breaking strain.

Assuming that the power of the press is settled, there is next to be considered the method of load, which will determine the bending moment from which is obtained the amount of material required to take the stress.

The depth of the girder is a most important matter to consider; greatest depth means greatest moment of inertia and least weight.

The flange of cylinder requires to be strong enough to take the shear, and of sufficient width for crushing strain; this latter point is sometimes neglected with disastrous results. The open gap type of machine is usually adopted for hydraulic punching, shearing, forging, and welding presses up to 300 tons power.

Although the design of every part of a press is of importance, none is more so than the operating valves.

(*To be continued.*)

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts.

CONTRACTS OPEN.

Last Day.

G.W. & Midland Railways.—Erection of a steel foot-bridge at Oldminster, near Sharpness. Engineer, Paddington Station, W. ... Feb. 6

Ilford.—Supply of 2,400 yds. of 4-in. concentric armoured cable. Electrical Engineer, Electricity Works, Ley Street, Ilford ... Feb. 7

Widnes.—Sinking two bore-holes at Stocks Wells Pumping Station. Mr. Isaac Carr, Engineer, Widnes ... Feb. 7

Brusssels.—Establishment of a central electric lighting station at the new goods station near the Brussels Dock for Belgian State Railways. Particulars at La Bourse, Brussels ... Feb. 8

West Ham.—Supply of engine-room stoves, cable, integrating wall-meters, etc. Borough Electrical Engineering Central Station, Tucker-street, Canning Town ... Feb. 9

Ghent.—Supply of fifteen electric cranes for use in connection with the docks. Hotel de Ville, Ghent ... Feb. 13

Bury.—Supply and erection of one 500 k.w. direct-current high-speed generating set. Mr. S. J. Watson, Electricity Works, Bury Feb. 14

Lagos.—The Crown Agents for the Colonies invite tenders for the supply of steel rails, fish-plates, and steel sleepers for thirty miles of single track. Crown Agents Office, Whitehall Gardens, S.W. ... Feb. 14

Merthyr Tydvil.—Supply of between 5,700 and 6,000 tons of cast-iron pipes for high-level aqueduct, valves, etc. Mr. George F. Deacon, 16, Great George Street, Westminster, S.W., or Clerk, Town Hall, Merthyr Tydvil ... Feb. 15

Bournemouth.—Three contracts in connection with tramways. (a) Steel grooved girder rails; (b) permanent-way construction and rail bonding; (c) wood blocks and granite at edging. Mr. F. W. Lacey, Borough Engineer, Bournemouth ... Feb. 15

Copenhagen.—Supply and erection of a gasometer of a capacity of 200,000 cubic feet per hour for the Lighting Department of the Corporation. Valby Gasworks, Valby, Copenhagen ... Feb. 27

Barcelona.—The "Gaceta de Madrid" of January 18th contains a notice calling for tenders for the supply and installation in the sheds of the Barceloneta wharf of two transhipment cars for platform cranes. Conditions of contract and plans may be inspected at the offices of the Secretary of the Port Administration, Casa Lonja, Barcelona ... March 1

Johannesburg.—Supply of 100 electric cars, two electric water-cars, five-ton crane, car traverser, and workshop tools for Municipal Council ... March 6

Last Day.

Belgium.—The "Bulletin Commercial" announces that the Belgian State Railways invite tenders for the installation of two sets of ventilating and heating apparatus in the central workshops at Mechlin. Particulars of M. Slaghmuylder, Engineer-in-chief, Station du Nord, Brussels ... March 6 March 13

Madagascar.—Plant and machinery are required for the establishment of a pumping station at Majunga, Madagascar. Particulars may be obtained from the Minister of the Colonies, 4, Rue Jean Nicot, Paris ... —

Chile.—News has been received at the Commercial Intelligence Branch of the Board of Trade from the British Vice-Consul, at Santiago (Mr. A. C. Kerr), notifying that tenders for the Valparaiso harbour works will be opened in April, 1906. Specifications will be sent to the various Chilian Legations in Europe and the United States ... Apr. 1906

COMING CONTRACTS.

Cape Colony.—The Cape of Good Hope Government Gazette of December 30th notifies the intention of the Town Council of Somerset East to proceed with the raising of a loan of £10,000 for the purpose of carrying out the new water scheme passed by public meeting.

Natal.—The Natal Government Gazette of December 13th contains notices of applications for leave to introduce Bills into the Legislative Assembly of Natal to authorise the construction and working of tramways either by electricity or other power. The Gazette may be seen at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, E.C.

Gorton.—The District Council is seeking powers to construct tramways (single track with passing places) from the Manchester city boundary, along Gorton Lane and Wellington Street to Hyde Road, and from Hyde Road along Reddish Lane to the boundary of the Gorton Urban District.

China.—The "Dépêche Coloniale" states that a railway from Nanchwang to Kiukiang is about to be constructed at a cost of 4,000,000 taels (one tael = between 5s. 6d. and 6s.); half of this sum will be subscribed by natives in Kiangsi, and the remainder will be met by a subsidy from the Government.

West Ham.—The Board of Trade has sanctioned the borrowing of the following sums for electrifying the High Street, Romford Road, and Leytonstone Road lines of tramway: £29,850 for the permanent way; £10,100 for electrical equipment; and £18,550 for the provision of cars.

Italy.—A company has just been formed in Brussels with a capital of £50,000, to be known as La Compagnie Italo-Belge des Tramways Electriques de Verona, to construct and work a system of electric tramways in the town of Verona. The object of the company is to acquire the tramways (about 4 km. in length) in the town of Verona and convert the same to electric traction on the overhead system and to construct a further 4 km. of lines.

CONTRACTS CLOSED.

Perth.—The British Electric Plant Company, Ltd., of Alloa, informs us that it has been awarded the contract by the Perth Corporation for a 500-kilowatt compound traction generator, together with engine for the same, the combined set having an overload capacity of 600 kilowatts.

Erith.—Messrs. Mountain and Gibson, of Bury, inform us that they have secured the contract from the Erith District Council for fourteen of their electric motor-trucks for tramways, and for one sweeping and watering car.

Bury.—The Holwell Iron Company, Ltd., of Ashford by Melton Mowbray, has secured the order for the cast-iron pipes required for Contract No. 1 of the Bury and District Joint Water Board, Lancs.

New York.—The New York Central and Hudson River Railroad Company has placed an order with the General Electric Company, of New York, for 60,000 h.p. in Curtis steam turbo-alternators, consisting of eight units of 7,500 h.p. each. This will be, when completed, the largest steam-turbine installation of any kind in the world.

Birkenhead. -- The Tranmere Bay Development Company, Ltd., Birkenhead, have placed a contract with the Power-Gas Corporation, Ltd., for a gas-driven electric installation for their new shipyard at Birkenhead. The installation consists of a power-gas plant of 6,000 h.p. capacity. The electric generating plant comprises two 400 i.h.p. Premier gas engines, each direct coupled to a Bruce-Peebles 220 kw. dynamo, and three 250 i.h.p. Premier gas engines, each direct coupled to a Bruce-Peebles 140 kw. dynamo.

Maritzburg.—Tenders for the additional generating plant required for the Maritzburg tramways have been under consideration by the Town Council. The acceptance is recommended of Messrs. Collins, Kessler and Co.'s tender for a Williams and Robinson-Parker 250 k.w. traction set for the sum of £2,161.

London.—The Brush Electrical Engineering Company has been awarded the following contracts: 18 double-deck car-bodies, with Brush trucks and equipment for Leith Corporation; power-house plant, consisting of three 400 kw. steam turbo-generators, condenser, pumps, pipe-work, etc., for Port Elizabeth.

Belfast.—Messrs. Combe Barbour are building three vertical triple high-speed engines of the enclosed type for the Belfast Tramway Power Station for direct coupling to Westinghouse generators. Each engine will develop 1,550 B.H.P. at 180 revolutions.

Bury.—Messrs. Mountain and Gibson have secured the contract from the Bury Council for fourteen M. G. 21 E. M. electric motor trucks for tramways, and for one sweeping and watering car mounted upon one M. G. 21 E. M. tramway truck.

Glasgow.—Messrs. Connal and Co., Ltd., of Glasgow, have placed with Messrs. A. and J. Main and Co., Ltd., of Possilpark, for the erection on their ground at Mavisbank Quay, Glasgow, of a large iron shed for the storage of goods.

London County Council.—The London County Council have placed an order for a powerful motor steam fire-engine for the London Fire Brigade with Messrs. Merryweather and Sons, Ltd. It will be capable of delivering 500 gallons per minute, using oil fuel, and be able to turn out under full steam in sixty seconds from a call.

Transvaal.—Among recent orders secured by the Worthington Pump Co. for condensing machinery, is one for a large cooling-tower plant for the Premier (Transvaal) Diamond Mining Company.

APPOINTMENTS VACANT.

	Last Day.
East Indian Railway.—Assistant locomotive superintendent. Salary Rs. 350 rising to Rs. 400 per calendar month. Mr. C. W. Young, Secretary, 28, Nicholas Lane, E.C.	Feb. 11
India Office.—Assistant engineers in the permanent establishment of the Indian Public Works' Department. Secretary, Public Department, India Office, Whitehall, S.W.	May 1
West Bromwich.—Assistant electrical engineer at an initial salary of £120 per annum. Mr. John H. Wray, Electricity Works, West Bromwich	Feb. 4
Birmingham.—Chemist to take charge of a new 20-ton per diem coal-testing plant, fitted with regenerative retort settings. Chairman of Works, Sub-Committee of Gas Department, Council House, Birmingham	Feb. 20
City Corporation.—Mr. D. J. Ross, engineer and surveyor to the City Corporation, is retiring on account of ill-health. At a joint meeting of the Officers and Clerks, the Finance and the Improvements committees, it was decided to advertise for a successor. The salary was fixed at £1,500, rising to £2,000. Candidates must not be over fifty years of age	—

APPOINTMENTS FILLED.

Indian Railway Board.—Mr. Walter H. Wood, general manager of the Hull and Barnsley Railway, has been appointed the English member of the new Indian Railway Board, whose numbers are now complete.

Chesterfield.—Mr. R. L. Acland has been appointed to the joint offices of electrical engineer and manager of the Chesterfield tramways department at an initial salary of £350 per annum.

Johannesburg.—Mr. Leitch, formerly town engineer at Johannesburg, has been appointed Consulting Civil Engineer to the Council at a fee of £500 per annum. The appointment is subject to the approval of the Rand Water Board.

India. — Mr. Frank Cartwright, A.M.Inst. C.E., has been recommended by the Government of Bombay for the post of State Engineer to His Highness the Maharajah of Rewa.

Northampton Institute.—Mr. H. M. Hobart has been appointed lecturer in electrical engineering design at the Northampton Institute, Clerkenwell, in succession to Mr. E. Kilburn Scott, who has been appointed lecturer in electrical engineering in the University of Sydney. Mr. M. Holroyd Smith has been appointed chief assistant in the mechanical engineering department at the same Institute, in succession to Mr. W. E. Curnock, who has been appointed head of the mechanical engineering department of the Technical College, Huddersfield.

Brighton.—Mr. M. H. Volk, who has just resigned his position as works engineer to the Brighton Corporation tramways department, is about to take up an appointment as engineer and manager to the Brighton Beach electric railway.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

he following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares business is currently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our List will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from le inaccuracies.

Stock Exchange Settling Days.—Settling days on the Stock Exchange are as follows :—
sols: February 1st. General Settlements: February 10th, 24th, March 15th. Bank Rate, April 21st, 1904, 3 per cent.

—ENGINEERING, IRON, AND STEEL COMPANIES.

d.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
70	5	5%	Alldays & Onions Pneumatic Engineering, Ltd.	3	2½— 3
00	5	3/-	Do. Cum. Pref. 6 per cent. ..	5	4½— 5
00	1	2/6	Armstrong (Sir W. G.), Whitworth and Co., Ltd.	1	3 5/16 — 3 7/16
70	5	2/-	Do. 4% Cum. Pref.. ..	5	5⅜— 5⅝
00	100	4%	Do. 4% 1st Mort. Dbs. Rd.	100	102 —104
00	100	4½%	Aveling and Porter, Ltd., 4½% Reg. Mt. Debs. Red.	100	96 — 99
00	1	1/7½	Babcock and Wilcox, Ltd., Ord. ..	1	3½— 3⅝
00	1	7½d.	Do. ,, 6% Cum. Pref.	1	1½— 1⅝
00	5	3/-	Baker (Joseph) and Sons, Ltd., 6% Cum. Pref.	5	5 — 5½
00	1	6⅝d.	Baldwins, Ltd., 5½% Cum. Pref. ..	1	1 — 1⅛*
00	Stk	4½%	Do. 1st Mt. 4½% Deb. Stk. Red.	100	101 —103
00	4½	2/8⅝	Barrow Hæmatite Steel Co., Ld., O.	4½	1 9/16— 1 11/16
00	4½	6/-	Do. do. Cum 2nd. Pref.	4½	4¼— 4¾
34	5	2/6	Bayliss, Jones and Bayliss, Ltd., 5% Cum. Pref. Shares	5	4¾— 5¼
00	100	—	Beardmore (Wm.) & Co., Ltd., 4½% 1st Mt. Debs., Red., Scrip 50% pd	—	100 —102
00	10	6/-	Bell Brothers, Ltd., 6% Cum. Pref.	10	11½— 12*
00	Stk	4%	Do 4% Deb. Stock, Red.	100	99 —101
50	1	6d.	Bengal Iron and Steel Ord.	1	1 — 1½
00	1	1/-	Beyer, Peacock and Co., Ltd., Ord.	1	25/32— 27/32
00	1	6⅝d.	Do. 5½% Cum Pref.	1	13/16— ⅞*
00	Stk	4½%	Do. 4½% Red. Deb. Stock	100	94 — 97
50	1	6d.	Bolckow, Vaughan and Co., Ltd., O. Nos. 1-1,629,760	1	1 — 1 1/16
00	1	3⅜d.	Do. Nos. 1,639,101-3,500,000	12/-	17/32— 19/32
00	1	4½d.	Brown (John) and Co., Lim., Ord., Nos. 1-1,160,000	15/-	1½— 1⅝
00	1	6d.	Do. Ord., Nos. 1,160,001-1,750,000	1	1 25/32— 1 27/32
00	10	5/-	Do. 5 % Cum. Pref.	10	11¼— 11¾
00	5	2/6	Cammell, Laird & Co., Ltd., Ord...	5	8¾— 9¼
00	5	2/6	Do. 5% Cum. Pref. ..	5	5¼— 5⅝
00	1	1/6	Clayton & Shuttleworth, Ltd., Ord.	1	31/32— 1 1/32
00	5	2/6	Do. 5% Cum. Pref.	5	5¼— 5½
00	Stk	4%	Do 4% 1st Mort. Db. Stk. Red	100	100 —102
00	10	30/-	Consett Iron Co., Ltd., Ord.. ..	7½	33 — 35
31	10	10/-	Crossley, Bros., Ld., Ord. 40340/97370	10	15¾—16¼
39	10	5%	Do. 5% Cum. Pref.	10	11⅜—11⅝
00	1	2/6	Delta Metal, Ltd. Shares	1	2 — 2½
94	1	3⅜d.	Dorman, Long & Co., Ltd.	1	23/32— 25/32
00	Stk	4%	Do. 4% 1st Mort. Perp. Deb. Stk.	100	90 — 93
00	Stk	—	Do. 6% 2nd Mort. Deb. Stk, Red.	—	94 — 96
00	5	3/-	Dunderland Iron Ore Co., Ltd., 6% Cum. Pref. and Participating..	5	3 — 3¼
00	1	9⅜d.	Dunlop (James) & Co., Ltd., Ord...	1	⅝— ¾
00	1	7½d.	Do. 6% Cum. Pref. ..	1	15/16 - 1 1/16
21	13	12/-	Ebbw Vale Steel, Iron & Coal Co., Ltd.	13	9 — 10
54	13	12/-	Do. do. do.	10	7⅞— 8⅛
50	10	8/-	Elliott's Metal, Ltd.	8	4½— 5½
00	10	5%	Do. Cum. Pref. 5%	10	8¾— 9¼
48	Stk	4%	Do. Deb. 4%	100	94½ - 96½
00	10	6/-	Fairfield Shipbuilding & Engng. Co., Ltd., 6% Cum. Pref. ..	10	10½— 11
00	Stk	4½%	Do. 4½% Mort. Deb. Stk. Red.	100	97 —100
00	10	10%	Fleming & Ferguson, Ltd, Ord. Nos. 1/9000..	10	12 —12¼
C0	10	5%	Do. 5% Cum. Pref. Nos. 9001/15000	10	9¾—9⅞
00	3	3/-	Fraser & Chalmers, Ltd., Ord. ..	3	4⅝— 4⅞
00	3	1/6	Do. 7½% Cum. Pref.	3	5½— 6
00	10	5%	Galloways, Ltd., 5% Cum. Pref. 18001/28000	10	6 — 7
00	Stk	4%	Do. 4% 1st Mort Deb Red..	100	90½—91½
00	1	1/-	Guest, Keen & Nettlefolds, Ltd. Ord.	1	2¼— 2⅜
00	5	2/6	Do. 5% Cum. Pref.	5	5⅞— 6⅛
00	Stk	4%	Do. 4% Irred. Mort. Deb. Stk	100	105 —107
00	5	2/6	Gwynnes, Ltd., 5% Cum. Pref. ..	5	2 — 3
00	1	1/-	Hadfield's Steel F'dry Co., Ld., Ord.	1	3⅜— 3½
00	10	4/6	Do. 4½% Cum. Pref.	10	10½— 11
00	5	3/-	Hall (J. & E.), Ltd. 6% Cum. Pref...	5	5 — 5½*
05	1	1/6	Harvey United Steel Co., Ltd. ..	1	1 5/16— 1 7/16
00	10	7½%	Hawthorn, Leslie & Co., Ltd. Ord.	10	11 —11½
01	5	7/-	Head, Wrightson & Co., Ltd. ..	5	4¾— 5¼
00	1	7½d.	Hill (Richard) & Co. (1899) Ld., Ord.	1	13/16— 15/16
00	5	3/-	Do. 6% Cum. Pref.	5	4½— 5
00	10	6/-	Hornsby (Richard) & Sons, Ld., Ord.	8	5¾— 6¼

ENGINEERING, IRON, AND STEEL COMPANIES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
750,000	1	6d.	Howard & Bullough, Ltd., Ord. ..	1	1 11/16—1 13/16
25,000	10	6/-	Do. 6% Pref. (Non-Cum.) ..	10	12¼— 12¾
£250,000	Stk	4%	Do. 4% Deb. Stk., Red. after 1905	100	98 —101
37,500	10	20	Kynoch, Ltd.	10	19 — 20
49,537	10	5%	Do. Cum. Pref. 5%	10	10¾— 11¼
300,000	1	4½d	Lambert Bros., Ltd., Ord.	1	⅝— ⅞
50,000	5	2/9	Do. 5½% Cum. Pref.	5	4 — 4½
40,000	3	2/1½	Leeds Forge Co., 7% Cum. Pref. ..	3	3¾— 4¼
200,000	1	7½d.	Lysaght (John), Ltd., 6% Cum. Pf.	1	1 5/16— 1 7/16
£300,000	Stk	4½%	Do 4½% 1st Mt. Deb. Stk., Red.	100	108 —110
40,000	10	5/-	Mather & Platt, Ld., 5% Cum. Pref	10	11 — 11½
210,000	1	6d.	Measures Bros., Ltd., Ord.	1	⅝— ¾
75,000	1	6⅝d.	Do. 5½% Cum. Pref.	1	13/16— 15/16
£75,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	96 — 99
21,943	5	2/6	Muntz Metal, Ltd.	5	5 — 5¼
14,248	5	5%	Do. Pref. 5%	5	5⅛— 5⅜
5,000	62½	47/6	Nantyglo and Blaina Iron Works, Ltd., 8% Cum. Pref.	62½	74 — 76
73,000	10	5/-	N. Brit. Loco. Co., Ltd., 5% Cm. Pf.	10	11¾— 12
80,000	5	—	North-Eastern Steel Co., Ltd., Ord.	5	—
£250,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	90 — 93
122,000	5	2/-	Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B"	5	3¾— 4
50,000	5	3/-	Do. 6% Cum. Pref. "A" ..	5	5¾— 6¼
70,000	10	6/-	Pease & Partners, Ltd., Ord. ..	10	9½— 10
£400,000	Stk	4%	Do. 4% Perp. Deb. Stock .	100	97 —100
20,000	5	3/-	Peebles (Bruce) & Co., Ld., 6% Cm.P.	5	4¾— 5
65,000	1	—	Pooley (Henry) & Son., Ltd., Ord ..	1	3/-—4/-
13,000	5	—	Do. 5½% Cum. Pref.	5	2¾— 3
230,000	1	—	Projectile Co. (1902), Ltd., Ord. ..	1	9/16— 11/16
126,938	5	2/-	Rhymney Iron Co., Ltd.	5	1¾— 2
73,062	5	2/-	Do. New	5	1 11/16— 1 13/16
£330,000	—	5%	Do. 5% Mort. Deb., Red. ..	100	99 —102
350,000	1	7½d.	Richardsons, Westgarth & Co., Ltd., 6% Cum. Pf. ..	1	31/32— 1 1/32
£350,000	Stk	4½%	Do. 4½% Perp. Deb. Stock ..	100	95 — 97
35,000	10	12/-	Ruston, Proctor & Co., Ltd... ..	10	9¼— 9¾
275.000	1	6d.	Scott (Walter), Ltd., Ord.	1	⅞— 1
300,000	1	7½d.	Do. 6% Cum. Pref. ..	1	1— 1⅛
£300,000	Stk	4%	Do. 4% Perp. Deb. Stk.	100	94 — 96
£115,300	100	5%	Shelton Iron, Steel and Coal Co., Ld. 1st Charge 5% Debs.. Red ..	100	90 — 93
£97,900	100	6%	Do. 6% 2nd Mort. Debs., Red.	100	91 — 95
250,000	1	1/-	South Durham Steel & Iron, Ltd. Or.	1	19/32— 21/32
300,000	1	7½d.	Do. 6% Cum. Pref...	1	13/16— ⅞
£300,000	Stk	4½%	Do. 4½% Per. Deb. Stock	100	89 — 92
49,560	10	2½%	Steel Co. of Scotland Ord. 1/49560..	9	5½— 5⅝
£125,240	Stk.	—	Do. 5% Trust Mort. Deb. ..	100	106½—107½
25,000	10	—	Stephenson (Robert) & Co., Ltd., Or.	10	2 — 2¼
25,000	10	5/6	Do. 5½% Cum. Pref. ..	10	4¼— 4½
£250,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	76 — 78
85,000	10	9/-	Stewarts & Lloyds, Ltd., Ord. ..	10	17½— 18
55,000	10	6/-	Do. 6% Cum. Pref.	10	14¼— 14¾
634,732	1	4.69d.	Swan, Hunter & Wigham-Richardson, Lim. Ord.	1	⅞— 1
538,845	1	6d.	Do. 5% Cum. Pref.	1	⅞— 1
£240,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Red	100	98 — 101
300,000	1	6d.	Thames Iron Works, Shipbuilding & Engineering Co., Ltd., 5% Cum. Pf.	1	½— 9/16
£200,000	100	4%	Do. 4% Irredeem. 1st Mort. Deb.	100	67 — 71
£160,000	1	7½d.	Thornycroit (John I.) & Co., Ltd. 6% Cum. Pref.	1	15/16— 1 1/16
10,000	10	5/-	Tylor (J.) & Sons, Ltd. 5% Cum. Pf.	10	9½— 10
$508495200	$100	$½	United States Steel Corp. Com. Stk.	$100	31 — 31½
$360314100	$100	$1¾	Do. 7% Cum. Pref. Stock	$100	96½— 97
$162268000	$ 1000	5%	Do. 10-60yr. 5% Skg. Fd. G. Bds.	$1000	96 — 98
3,350,000	1	1/-	Vickers, Sons & Maxim, Ltd. Ord..	1	2 9/16— 2 11/16
750,000	1	6d.	Do. 5% Non-Cum. Pref. ..	1	1⅛— 1¼
£750,000	Stk	5%	Do. 5% Non-Cum. Pref. Stock.	100	114 —117
£1,250,000	Stk	4%	Do. 4% 1st. Mort. Deb. Stk. Red.	100	105 —107
£1,000,000	100	4½%	Do. 4½% 2nd Mort. Debs., Red.	100	104 —106
225,000	1	1/2⅜	Weardale Steel, Coal & Coke, Ltd., Def. Ord.	1	13/16— 15/16
500,000	1	7½d.	Do. 6% Cum. Pref. Ord. ..	1	⅞— 1*
£300,000	Stk	4%	Do. 4% Perpetual Deb. Stock	100	85 — 89
7,637	5	2/9	Weldless Steel Tube, Ltd., Cum. Pref. 5½	5	4¾— 4⅞
300	Stk	4½%	Do. Mort. Deb. 4½%	100	91 — 97
66,666	5	3/.	Willans & Robinson, Ord.	5	1 — 2
66,666	5	3/-	Do. 6% Cum. Pref.	5	3 — 4
£246,641	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red	100	74 — 79
£150,000	Stk	4½%	Yorkshire Iron & Coal Co., Ltd., 4½% 1st Mort. Deb. Stk. Red.	100	81 — 86

Stocks and Shares marked * are quoted ex-dividend.

II.—ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
70,000	1	6d.	Alliance Elec. Co., Ltd. 5% Cum. Pf.	1	⅝— ⅞
125,000	1	7½d.	Aron Elec. Meter Ltd., 6% Cum. Pf.	1	7/16— 9/16
120,000	1	9⅜d.	Bell's Asbestos Co., Ltd.	1	11/16— 13/16
100,000	5	4/-	British Insulated & Helsby Cables Ltd., Ord. ..	5	5¼— 5¾
100,000	5	3/-	Do. 6% Cum. Pref.	5	5 —5½*
£500,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Rd.	100	101 —104
£200,000	Stk	4½%	British Thomson-Houston Co., Ltd., 4½% 1st Mort. Deb. Stk. Red. ..	100	101 —103
400,000	5	3/-	British Westinghouse Electric and Manufac. Co., Ltd., 5% Pref. ..	5	2⅝— 2⅞
£616,353	Stk	4%	Do. 4% Mort. Deb. Stk. Red...	100	86 — 88
105,731	2	2/-	Brush Elec. Enging. Co., Ltd., Ord..	2	½— ¾
150,000	2	2/4½	Do. 6% Pref.	2	1¼— 1½
£125,000	Stk	4½%	Do. 4½% Perp. 1st Deb. Stk...	100	93 — 96
£125,000	Stk	4½%	Do. 4½% Perp. 2nd Deb. Stk.	100	74 — 77
35,000	5	5/-	Callender's Cable & Constn. Ltd. Ord.	5	9½ - 10
40,000	5	2/6	Do. 5 % Cum. Pref.	5	5⅛ - 5⅜
£200,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Red.	100	104 —106
85,000	3	1/6	Crompton & Co., Ltd...	3	2¼— 2¾
£100,000	—	5%	Do. 5% 1st Mort. Reg. Debs.	100	93 — 98
52,000	5	10/-	Dick, Kerr & Co., Ltd., Ord. ..	5	8 — 8½
61,000	5	3/-	Do. 6% Cum. Pref.	5	5¾— 6
£300,000	Stk	4½%	Do. 4½% Deb. Stock, Red. ..	100	105 —107
233,334	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	1⅛— 1⅜
£233,334	Stk	4%	Do. 1st Mort. 4% Iree. Deb. Stk.	100	105 —108
99,261	5	1/6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	3	⅝— ⅞
17,139	5	2/6	Do. "A" Shares Nos. 01-017,139	5	1 — 1⅛
£344,023	Stk	4%	Do. 4% Deb. Stock Red. ..	100	77 — 82
£100,000	Stk	5%	Do. 5% Second Deb. Stk. Red.	100	79 — 84
112,100	2	1/7½	Electric Construction Co., Ltd. ..	2	1⅛— 1⅜
31,390	2	2/9⅗	Do. 7% Cumulative Pref. ..	2	2¼— 2¾
£200,000	Stk	4%	Do. 4% Perp. 1st Mt. Deb. Stk.	100	97 — 99*
10,248	10	7/6	Evered and Co., Ltd.	10	13 — 15
£100,000	Stk	5%	Ferranti, Ltd., 5% 1st Mort. Deb. Stock, Red...	100	90 — 95
25,000	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9½— 10
£200,000	Stk	4%	Do. 4% 1st. Mt. Deb. Stk., Red.	100	91 — 96
35,000	5	5/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	10½— 11
35,000	5	2/3	Do. 4½% Cum. Pref... ..	5	5⅛— 5⅜
£50,000	Stk	4½%	Do. 4½% Mt. Deb. Stk. Red.	100	110 —112
50,000	10	5/-	India Rubber, Gutta Percha & Telegraph Works Co., Ltd.,	10	15 — 16
£300,000	100	4%	Do. 1st Mort. Deb. Red. ..	100	99 —102
7,500	10	—	Parker, Thos., Ltd.	10	6½— 7
100,000	1	3%	Scott (Ernest) & Mountain, Ld., Ord.	1	16/—16/6
37,350	12	12/-	Telegraph Construction and Maintenance Co., Ltd.	12	38 — 40
£150,000	100	4%	Do. 4% Deb. Bonds	100	101½-103½

III.—ELECTRIC TRACTION.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
120,000	5	3/-	Anglo-Argentine Trams Co., Ld., Or.	5	8 11/16— 8⅞
260,007	5	2/6	Do. 5% Cum Pf.	5	5¾— 5⅞
£230,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888 ..	100	140 —148
20,000	10	6/-	Barcelona Trams Co., Ltd., Ord. ..	10	12 — 12½
10,000	10	5/-	Do. 5% Cum Pf. Shares	10	9 — 10
£46,300	100	5%	Do. 5% Debs., Red. ..	100	99 —102
£191,316	Stk	4½%	Do. 4½% Red. Deb. Stk.	100	96 —100*
75,606	1	—	Bath Elec. Trams. Ld., Pf. Or. ..		11/16— 13/16
59,394	1	11·49d	Do. 5% Cum. Pf. ..		15/16— 1 1/16
75,000	5	—	Brisbane Electric Tram Investment Co., Ltd., Ord... ..	5	1¼— 1¾
75,000	5	2/6	Do. 5% Cum. Pf. ..	5	3¾— 4¼
£426,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	94 —98
£200,000	Stk	6%	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	100 —103
		%	Pref. Ord. Stock	100	100 —103
188,301	10	6/-	Brit. Electric Traction, Ltd., Ord.	10	9¾—10¼
156,427	10	6/-	Do. 6% Cum. Pref... ..	10	11¼— 11½
£1,000,000	Stk	5%	Do. 5% Perp. Deb. Stk. ..	100	119 —121
£250,000	Stk	4½%	Do. 4% 2nd Deb. Stk. Red..	100	97 — 99
100,000	5	1/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	4 — 4½
40,500	5	3/-	Do. "A" 6% Cum Pref. ..	5	5¾— 6½
27,000	5	3/-	Do. "B" do.	5	5⅛— 5⅝

ELECTRIC TRACTION.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£200,000	Stk	5%	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	94 — 97
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	99 —102
102,268	5	3/-	Calcutta Tramways Co., Ltd. ..	5	8⅜— 8¾
£350,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	106 —108
480,000	1	6d.	Cape Electric Tramways, Ltd. ..	1	1⅛— 1¼
40,000	5	2/6	City of Birmingham Trams Co., Ltd. 5 % Cum. Pref.	5	4⅞— 5⅜
£300,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	101 —104
£120,000	Stk	5%	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	101 —104
60,000	10	6/-	Dublin United Trams. Co. (1896), Ltd., Ord. ..	10	13 — 14*
59,987	10	6/-	Do. 6% Pref...	10	15½— 16*
30,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	3½— 4
£150,000	Stk	4%	Do. 4% Deb. Stock.. ..	100	90 — 93
125,000	10	5/-	London United Trams. (1901), Ltd., 5% Cum. Pref.	10	10½—10¾
£1,031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	104 —106
£50,000	Stk	5%	Madras Electric Trams (1904), Ltd., 5% Deb. Stock, Red.	100	101 —103
314,016	1	—	Metropolitan Elec. Trams, Ltd., Def.	1	13/32— 17/32
500,000	1	6d.	Do. 5% Cum. Pref... ..	1	⅞— 1⅛
£350,000	Stk	4½%	Do. 4½% Deb. Stock, Red.	100	103 —105
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	½— 1½
110,923	8	2/9⅞	North Metropolitan Tramways Co..	8	4¾— 5¼
£150,000	100	3½%	Do. 3½% Mort. Debs.	100	90 — 95
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red..	100	102 —105
24,500	10	10/-	Potteries Elec. Traction Co., Ld., Or.	10	8 — 9
24,500	10	5/-	Do. 5% Cum. Pref. ..	10	8½— 9½
£220,000	Stk	4½%	Do. 4½% Deb. Stk., Red.	100	99 —102

IV.—ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
7,500	10	16/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. ..	10	12 — 12½
7,500	10	4/6	Do. 4½% Cum. Pref. ..	10	9½— 10
7,500	10	6/-	Do. 6% Cum. Second Pf. ..	10	11 — 12
£70,000	Stk	4½%	Do. 4½% Deb. Stock Red ..	100	103 —105
14,000	5	2/-	Bromley (Kent) Elec. Lt. & Pr. Co. Ld	5	5¼— 5¾
£50,000	Stk	4½%	Do. do. 4½% 1st Deb. Stk. Red.	100	101 —104
27,507	5	4/6	Brompton & Kensington Elec. Supply Co., Ltd. Ord. ..	5	10½— 11
12,493	5	3/6	Do. 7% Cum. Pref. Shares..	5	10¼— 10¾
60,000	5	3/-	Calcutta Elec. Sup. Cor. Ltd., Ord..	5	8⅜— 8⅞
£288,782	Stk	4%	Central Elec. Sup. Co., Ltd., 4% Gua. Deb. Stk. ..	100	105 — 108
70,000	5	4/-	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord... ..	5	8¼— 8¾
80,000	5	2/3	Do. do. 4½% Cum. Pref...	5	5⅜— 5⅞
£350,000	Stk	4%	Do. do. 4% Deb. Stk. Red.	100	101 —103
44,436	5	2/3	Chelsea Elec. Sply. Co., Ltd., Ord.	5	6¾— 7¼
£150,000	Stk	4½%	Do. do. 4½% Deb. Stk., Red	100	108 —110
70,595	10	5/-	City of London El. Lghtg. Co., Ld., O.	10	11¾— 12¼
40,000	10	6/-	Do. 6% Cum. Pref... ..	10	13½— 14
£400,000	Stk	5%	Do. 5% Deb. Stk., Red ..	100	121 —125
£300,000	Stk	4½%	Do. 4½% 2nd Deb. Stk., Red	100	101 —103
40,000	10	4/-	County of London Elec. Supply Co., Ltd., Ord.	10	9 — 9½
30,000	10	6/-	Do. 6% Cum. Pref.	10	12 — 12½
£400,000	Stk	4½%	Do. 4½% Deb. Stk., Red. ..	100	107 —110
70,000	5	2/6	Edmundson's Elec. Cor. Ltd., Ord.	5	6¼ - 6¾
70,000	5	3/-	Do. 6% Cum. Pref.	5	6 — 6½
£300,000	Stk	4½%	Do. 4½% 1st Mort. Db. Stk. Reg	100	106 —108
£80,000	Stk	5%	Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. Stk. Red.	100	86 — 91
10,000	5	2/-	Folkestone Elec. Supply Co., Ld., O.	5	5½— 6
£50,000	Stk.	4½%	Do. 4½% 1st Deb. Stk., Red.	100	101 —104*
15,000	10	—	Havana Electricity Co., Ltd... ..	10	9½—10½
13,000	5	3/6	Hove Elec. Lighting Co., Ltd., Ord.	5	7½— 8
£50,000	Stk	4½%	Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock, Red.	100	100—102
150,000	1	—	Kalgoorlie Electric Power & Lighting Corp, Ltd., 6% Cum. Pref.	1	3/16— 11/16
21,000	5	5/-	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord. ..	5	12¾— 13¼

Stocks and Shares marked * are quoted ex-dividend.

ELECTRIC LIGHTING AND POWER.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£135,000	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	102 —104
111,000	3	—	London Elec. Supply Corp., Ld., Ord.	3	2⅜ — 2⅝
60,000	5	3/-	Do. 6% Pref.	5	5 9/16 — 5 11/16
£371,895	Stk	4%	Do. 4% 1st Mort. Db. Stk., Red.	100	96 — 98
100,000	10	9/-	Metropolitan Elec. Sup. Co., Ld., Or.	10	17¾ — 18¼
76,121	5	2/3	Do. 4½% Cum. Pref.	5	5½ — 5⅝
220,000	Stk	4½%	Do. 4½% 1st Mort. Db. Sk., Red.	100	110 —115
250,000	Stk	3½%	Do. 3½% Mort. Deb. Stk., Red.	100	96 — 98
£250,000	—	4½%	Midland Elec. Corp. for Power Distribution, Ld., 4½% 1st Mort. Deb.	100	92 — 95
10,852	10	6/-	Notting Hill Elec. Ltg. Co. Ltd. Ord.	10	14½ — 15
£59,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	102 —104
16,500	5	2/6	Oxford Electric Co. Ltd., Ord. ..	5	6⅛ — 6⅜
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	98 —100
£84,700	100	4½%	Royal Elec. Co. (of Montreal) 4½% 20-yr. 1st Mort. Deb	100	100 —102
40,000	5	5/-	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	13¾—14¼
20,000	5	3/6	Do. 7% Pref...	5	8½ — 9
£150,000	Stk	3½%	Do. 3½% Deben. Stock, Red	100	98 —100
12,000	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2¾ — 3¼
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	83 — 87
65,000	5	3/-	South London Elec. Sup. Co., Ltd. O.	5	4⅛ — 4⅜
100,000	1	—	South Metropolitan Elec Light & Power Co., Ltd. Ord.	1	⅞ — 1
50,000	1	8⅖d.	Do. 7% Cum. Pref.	1	1⅜ — 1 7/16
£100,000	Stk	4½%	Do. 4½% 1st Deb. Stock Red.	100	107 —110
50,000	5	2/6	Urban Electric Supply Co., Ltd., O.	5	5 — 5⅛
30,000	5	2/6	Do. 5% Cum Pref.	5	5 1/16 — 5 3/16
£200,000	Stk	—	Do. 4½% 1st Mort. Deb. Stk. Red	100	105 —107
110,000	5	6/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	13 — 13½
28,151	5	2/6	Do. 5% Cum. Pref.	5	6 — 6½

V.—TELEGRAPH & TELEPHONE COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£34,800	100	4%	African Direct Tel. Co., Ld., 4% Mt. Debs. (Series A), Red.	100	99 —102
25,000	10	—	Amazon Telegraph Co., Ld... ..	10	1 — 1½
£763,580	Stk	12/6	Anglo-American Tel. Co., Ltd., Ord.	100	56 — 58
£3,118,210	Stk	25/-	Do. 6% Preferred Ordinary	100	102 — 104
£3,118,210	Stk	2/-	Do. Deferred Ordinary ..	100	11½ — 11¾
44,000	5	3/-	Chili Telephone Co., Ltd.	5	6⅛ — 6⅜
$15,000,000	$100	$2	Commercial Cable Co., Capital Stk.	$100	170 —190
£1,903,856	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	95 — 97
16,000	10	5/-	Cuba Submarine Tel. Co., Ld., Ord.	10	8¾ — 9¼
6,000	10	10/-	Do. 10% Preference	10	16½ — 17½
6,000	5	2/-	Direct Spanish Telegraph Co., Ord.	5	3⅜ — 3⅝
		5/-	10% Cum. Preference	5	7¾ — 8¼
£30,000	50	4½%	Do. 4½% Debs...	50	100-102%
60,710	20	3/-	Direct U.S. Cable Co., Ltd... ..	20	10⅜—10⅞
£85,800	100	4½%	Direct West India Cable Co., Ltd., 4½% Reg. Debs.	100	99 —101
£300,000	100	4%	East. & S. African, Ld., 4% Mt. Dbs.	100	101 —103
£200,000	25	4%	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)..	25	100-102%
300,000	10	2/6	Eastern Extension, Australasia and China, Ltd...	10	13½ — 14
£602,400	Stk	4%	Do. 4% Mort. Deb. Stk., Perp.	100	104 —106*
£4,000,000	Stk	25/-	Eastern Tele. Co., Ltd., Ord. ..	100	134 —137
£2,000,000	Stk	17/6	Do. 3 % Pref.	100	87 — 89
£1,836,814	Stk	4%	Do. 4% Mort. Deb.	100	105 —107
150,000	10	5/-	Great Northern Telegraph Co., Ltd., (of Copenhagen) ..	10	29¼ — 29¾
£58,700	100	4½%	Halifax and Bermudas Cable Co., Ltd., 4½% 1st. Mort. Debs. Red.	100	99 —101
17,000	25	12/6	Indo-European Tele. Co., Ltd. ..	25	45 — 47
72.680	1	7½d.	Monte Video Telephone Co., Ltd., O.	1	13/16 — 15/16
£1,983,333	Stk	6%	National Telephone Co., Ltd., Pref.	100	108½—109½
£1,966 667	Stk	5%	Do. Deferred	100	108—110
250,000	5	2/6	Do. 5% Non-Cum. 3rd Pref.	5	5¼ — 5½
£2,000,000	Stk	3½%	Do. 3½% Deb. Stk., Red. ..	100	96 — 98
£689,598	Stk	4%	Do. 4% do. do. ..	100	101 —103
179,318	1	7½d.	Oriental Telephone & Elec. Co., Ltd.	1	1 — 1⅛
50,000	1	7½d.	Do. 6% Cum. Pref.	1	1⅛ — 1¼
£100,000	100	4%	Pacific & European Tel. 4% Guar. Debs. Red...	100	96 — 99
11,839	8	4/-	Reuter's Telegram Co., Ltd. ..	8	7 — 7½
58,000	5	3/-	United River Plate Telep. Co., Ltd.	5	6⅞ — 7⅛
40,000	5	2/6	Do. 5% Cum. Pref.	5	5 — 5¼
£179,947	Stk	5%	Do. 5% Deb. Stock, Red. ..	100	105—107
15,609	10	4/-	W. African Telegraph Co., Ltd. ..	10	7¼ — 7¾
£30,008	2½	—	West Coast of America, Ltd. ..	2½	5/16 — 7/16
150,000	100	4%	Do. 4% Deb. Guar. by West. Tel.	100	99 — 101

TELEGRAPHS AND TELEPHONES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
88,321	10	6d.	W. India & Panama Teleg. Co., Ld., Or.	10	⅝ — ¾
34,563	10	6/-	Do. 6% Cum. 1st. Pref. ..	10	7⅜ — 7⅝
4,669	10	6/-	Do. 6% Cum. 2nd Pref. ..	10	6¾ — 7¼
£80,000	100	5%	Do. 5% Deb.	100	101 —103
207,930	10	3/-	Western Telegraph Co., Ltd. ..	10	13½ — 14
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	101 —103
518,915	Stk	4%	Do. 4% Deb. Stock, Red. ..	100	100½—102½

VI.—SHIPPING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
32,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 5½% Cum. Pref.	10	8½ — 9
£325,000	Stk	4½%	Do. 4½% Red. 1st Mort. Deb. Stk.	100	99 —101
£672,900	Stk	4½%	British & African Stm. Nav. (1900) Ltd., 4½% 1st Mort. Deb. Stk., Red.	100	93 — 95
40,000	10	5/6	Bucknall Steamship Lines, Ltd., 5½% Cum. Pref.	10	6 — 6½
£600,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk.	100	73 — 76
£750,000	Stk	4½%	Clan Line Steamers, Ltd., 4½% Deb. Stk. Red. ..	100	98 —100
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000..	20	13½ — 14
40,000	20	8/-	Do. Nos. 60,001-100,000	10	6 — 6½
£461,430	Stk	4½%	Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. ..	100	101 —103
1,200.000	1	6d.	Furness, Withy & Co., Ltd., Ord...	1	1⅛ — 1¼
25,328	7½	4/7	Gen. Steam Navigation Co., Ld., Ord.	7½	4¼ — 4¾
36,758	8	4/9⅗	Do. Non-Cum. 6% Pref.	8	7¼ — *7¾
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	97 — 99
55,000	5	1/3	Houlder Line, Ltd., Ord.	5	3 — 3½
40,000	5	2/9	Do. 5½% Cum. Pref.	5	3¼ — 3¾
£200.000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk. Red.	100	83 — 86
141,500	10	5/-	Leyland (Fredk.), & Co., (1900), Ltd., 5% Cum. Pref. ..	10	4½ — 5
£1,160,000	Stk	5 %	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. ..	100	126 —129
£1,160,000	Stk	19%	Do. do. Deferred ..	100	218 —221
15,000	100	30/-	Royal Mail Steam Packet Co. Ord..	60	26 — 27
39,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref..	5	4¾ — 5¼
39,075	5	2/6	Do. "B" Ord...	5	4 — 4½
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord..	10	8 — 8½
24,000	10	4/6	Do. 4½% Cum. Pref... ..	10	9¾ — 10¼
£1,008,894	Stk	4%	Do. 4% Debenture Stk., Red.	100	99 —101

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
60,000	1	9⅗d.	Chadburn's (Ship) Tele. Ltd., Ord...	1	⅞ — 1⅛
£750,000	Stk	5%	General Hydraulic Power Co., Ltd.	100	138 —143
12,500	10	10/-	Oakey (John) and Sons, Ltd., Ord..	10	24 — 26
10,000	10	6/-	Do. do. 6% Cum. Pf.	10	14 — 15
183,538	1	6·3d.	Power Gas Corp., Ltd., Ord., Nos. 66,463-250	15/-	5/16 — 7/16
66,462	1	8·4d.	Do. do. Nos. 1 66,462	1	9/16 — 11/16
135,000	1	6d.	Waygood (R.) & Co., Ltd., Ord. ..	1	1 1/16 — 1 3/16
135,000	1	7½d.	Do. 6% Cum. Pref. ...	1	1⅛ — 1¼

RAILWAY CARRIAGE & WAGON COMPANIES.

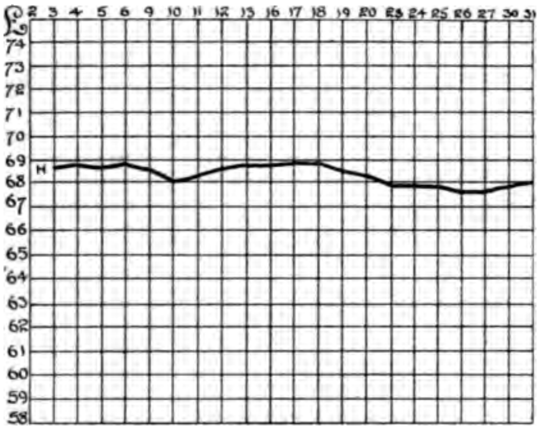
Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices
10,000	10	7/6	Birm. Railway-Car, & Wagon, L., 1-10,000	10	21¼ — 21¾
8,739	10	3/-	Do. Second Issue 1-8,739....	4	8¼ — 8¾
10,000	10	6/-	Do. Cum. Pref. 6% 1-10,000..	10	13 — 13½
30,111	7	7/-	Gloucester Rail.-Car & Wagon, Ld., A, 1-29,861 & 49,751-50,000	7	9 — 9½
44,889	7	3/6	Do. B, 29,862-49,750, 50,001-75,000	7	4 — 4½
14,567	10	1/3	Lancashire Wagon, Ord.	2	2 7/16 — 2 9/16
4,150	10	5%	Do. do.	10	10¾ — 10 13/16
784,808	1	9d.	Metropolitan Amalgamated Rail.-Carriage & Wagon, Ld., 1-784,808	1	39/9 — 40/3
164,288	1	6d.	Do. Cum. A Pref. 5% 1-164,288	1	23/6 —24/6
235,000	1	7½d.	Do. Cum. B Pref. 6% 1-235,000	1	28/3 —28/9
20,000	20	20/-	Midland Rail.-Car. & Wagon, Ld., 1-20,000	10	19 — 20

Stocks and Shares marked * are quoted ex-dividend.

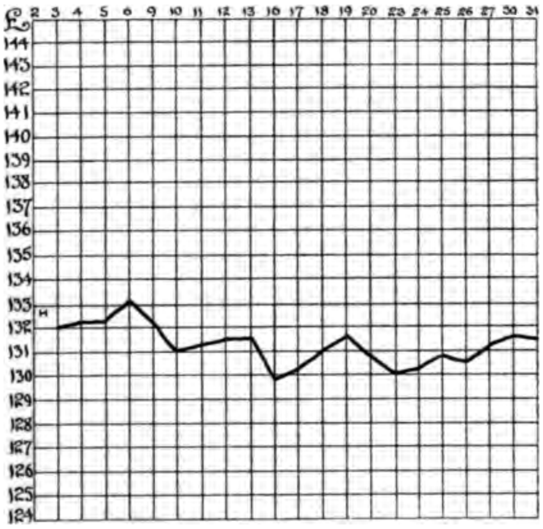
THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM JANUARY 2ND, 1905, TO JANUARY 31ST, 1905.

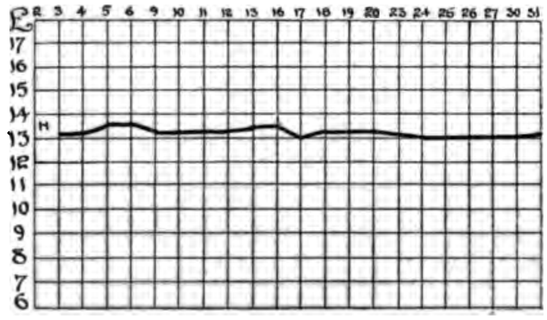
COPPER.



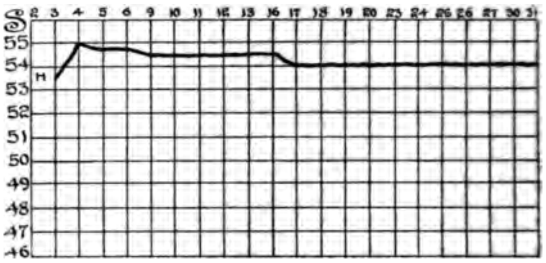
TIN.



ENGLISH LEAD.



PIG IRON: SCOTCH,



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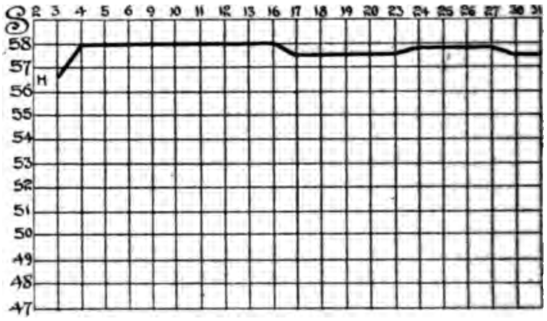
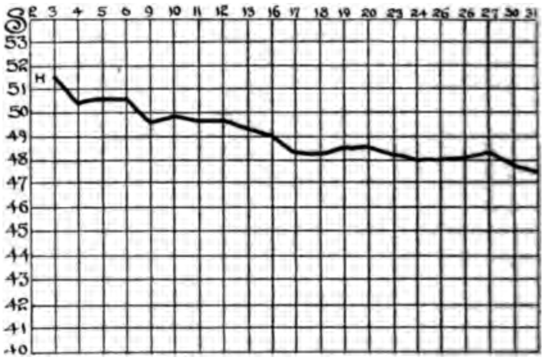
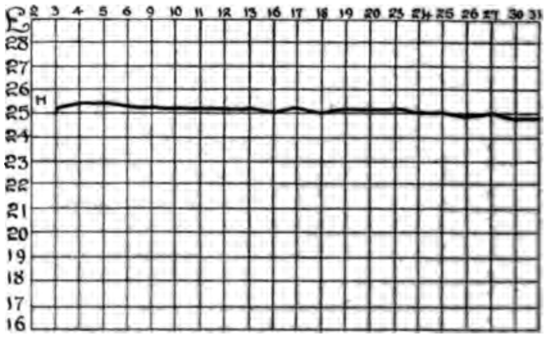


CLEVELAND.



SPELTER.



PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

MARKET REPORT.

Wednesday, February 1st, 1905.

VALUES in the copper market have moved within comparatively narrow limits. At one time a sharp fall seemed imminent, but the large offerings of metal were readily absorbed, and American trade advices still being favourably interpreted, the latest tendency is towards recovery, the improved tone being assisted by covering operations on the part of the bears. The present position is an interesting one. Messrs. Robert Katz and Co.'s circular points out that the greater consumption in America will be offset to some extent by the steady increase in production, but the balance of opinion is in favour of higher prices for copper.

Tin has been more active, quotations showing an upward trend in spite of the amount of metal sold in anticipation of the Banca sale. Good prices were realised at the sale, the parity of £132 per ton being realised for 57,400 slabs. The large quantity sold, as Messrs. Merton and Co. point out, had a temporary retarding effect on quotations, but good buying ensued, and with Eastern holders unwilling to sell, the market has firmed up.

Whatever the explanation, the slight check in the iron trade revival is disappointing. Probably, however, the halt called is only temporary, and certainly the weakness in pig iron had the effect of bringing in buyers and imparting a firmer tone to quotations. The German coal strike has had little or no effect on the home steel trade, but reports from the leading industrial centres are fairly encouraging, and with more activity in the shipbuilding yards promised, the outlook must be considered satisfactory.

Large arrivals of unsold metal from abroad depressed the lead market at the end of last week, but the demand has improved, and quotations at the time of writing show renewed strength. Soft foreign, prompt, is quoted £12 15s., and English £13.

Spelter has suffered from the realisation of speculative holdings. The statistical position is however unchanged. In their annual circular Messrs. Rudolph, Wolff, Kreuger and Co. point out that there was largely increased consumption in Germany and Great Britain last year, and that considerable quantities of spelter have been used for war material by both Russia and Japan.

IRON, STEEL, PIG-IRON, &c.

SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as follows. Prices delivered in Glasgow or equal:—

Steel:	£	s.	d.
Siemens' Steel Plates, Marine Boiler Quality	6	15	0
,, ,, ,, Land ,, ,,	6	17	6
,, ,, ,, Ship Quality Plates	5	17	6
Siemens' Steel Bars, Boiler Quality	6	17	6
,, ,, ,, Ship ,,	6	7	6
,, ,, Angles	5	7	6
Manufactured Iron:			
Bars—Dalzell	6	2	6
,, Best	6	12	6
,, ,, Horseshoe	6	12	6
,, Angle	6	2	6
,, Best Angle	6	12	6
,, Best Best	7	2	6
,, Extra Best	7	12	6

Usual terms and extras. Special rates for delivery in England and export. The above prices subject to alteration without notice.

The Glasgow Iron and Steel Co., Ltd., Wishaw, quote as under (prices are delivered Glasgow or equal):—

	£	s.	d.	
Steel Angles (Glasgow ♔ Steel)	5	8	9	per ton.
Steel Ship Plates (Glasgow ♔ Steel)	5	18	9	,,
Steel Bars, Ship Quality (Glasgow ♔ Steel)	6	8	9	,,
Steel Bars, Boiler Quality (Glasgow ♚ ♚ Steel)	6	18	9	,,
Steel Land Boiler Plates (Glasgow ♚ ♚ Steel)	6	7	6	,,
Steel Marine Boiler Plates (Glasgow ♚ ♚ Steel)	6	7	6	,,

Less 5 per cent. discount. Extras as per standard list.

Special prices for delivery in England and for export. The above prices subject to alteration without notice.

John Spencer (Coatbridge), Ltd., Phœnix Ironworks, Coatbridge, N.B., quotes:—

	£	s.	d.
Bars—Phœnix	6	5	0
,, Best	6	15	0
,, Best Best	7	5	0
,, Extra Best	7	15	0
,, Best Horse Shoe	6	15	0
,, Extra B.H.S.	7	15	0
,, Extra Best Cable	8	5	0
,, Rivet	6	5	0
,, Best Scrap Rivet	7	5	0

	£	s.	d.
Angles—Phœnix	6	5	0
,, Best	6	15	0
,, Extra Best	7	5	0
Gas Tube Hoops—Phœnix Best	6	15	0
Plates—Phœnix	—		
,, Best Boiler	7	10	0
,, Best Best Boiler	8	0	0
,, Extra Best Boiler	9	0	0
Boiler Tube Strips—Phœnix Best Best	8	0	0

All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly.

Messrs. R. Feldtmann and Co., of Glasgow, quote Commission extra).

Pig Iron:

	No. 1. £	s.	d.	No. 3. £	s.	d.
Coltness, f.a.s. Glasgow	3	5	0	2	15	0
Gartsherrie ,,	2	19	6	2	14	6
Summerlee ,,	3	0	6	2	15	0
Carnbroe ,,	2	17	6	2	14	0
Langloan ,,	3	4	0	2	16	0
Calder ,,	2	19	0	2	14	6
Clyde ,,	2	19	0	2	14	6
Glengarnock, f.o.b. Ardrossan	2	19	0	2	13	6
Eglinton ,, ,,	2	15	6	2	13	0
Dalmellington, ,, Ayr	2	15	6	2	13	0
Shotts ,, Leith	2	19	0	2	14	6

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, **at works**:—

	£	s.	d.
W.W. ♛ Bars	6	12	6
W.W. Best Bars	7	2	6
W.W. Best Best	7	12	6
W.W. Best Best Best	8	2	6
W.W. Best Shoe	7	2	6
Thornaby ♛	8	2	6
Thornaby Best	8	12	6
Thornaby Best Best	9	12	6
Whitwell Special Admiralty Cable	10	5	0
Special Chain Iron	9	5	0
Tube and Nail Strips	6	15	0
W.W. ♛ Angle Iron	6	15	0
W.W. Best Angle Iron	7	5	0
Tee Iron, to 8-inches United	7	12	6

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington, quote:—

	Iron. £	s	d.	Steel. £	s.	d.
Crown (BNF) Bars	6	10	0	7	5	0
,, ,, Angles	7	0	0	7	5	0
,, ,, Tees	7	10	0	7	15	0
,, (WIW) Hoops	7	0	0	7	10	0
,, ,, Sheets	7	10	0	8	0	0

Ordinary Sizes, F.A.S. Liverpool in 10-ton Lots.
Extras for Sizes and Cutting as per List.

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

Black Sheets:	Singles 20 G 96in. by 36in. per ton. £	s.	d.	Doubles 21 G to 24 G 96in. by 36in. per ton. £	s.	d.
"Vale"	10	0	0	10	10	0
"Shield"	10	10	0	11	10	0
"Severn"	11	10	0	12	10	0
"Baldwin Wilden B."	12	10	0	13	10	0
Charcoal	16	10	0	17	10	0
Best Charcoal	18	10	0	19	10	0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:	£	s.	d.	£	s.	d.
No. 3 Lead	13	10	0	14	10	0
S.V. Lead	15	0	0	16	0	0
No. 3 Terne	15	0	0	16	0	0
S.V. Terne	16	10	0	17	10	0

Tinned Sheets:	Singles 20 G to 108 by 36in. per ton. £	s.	d.	Doubles 21 to 24 G to 96 by 36in. per ton. £	s.	d.
Best Coke (Finish)	28	0	0	29	10	0
,, Charcoal (Finish)	30	0	0	31	10	0
Extra ,, ,,	32	0	0	33	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.

Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box.

Extreme sizes in Tin and Patent Coated specially quoted for.

Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.

At works less 2½% for cash monthly, 10th inst.

Galvanized Corrugated Sheets:

	£	s.	d.	
"Phœnix" Brand, 24 G., f.o.b. London, in Bundles	11	15	0	per ton.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	14	7	6	,,

Galvanized Working Up-Sheets:

	£	s.	d.	
24 G., f.o.b. London, in Bundles	13	15	0	per ton.

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£	s.	d.	
Crown Bars	6	10	0	per ton.
Best Bars (1 to 6in. wide, above ½ in. thick, ½ in. to 4 rounds and squares)	7	0	0	,,
Angles	6	15	0	,,
,, Best	7	5	0	,,
T's	7	0	0	,,
,, Best	7	10	0	,,
Best Shoe Iron	8	0	0	,,
,, Rivet Iron	8	0	0	,,
,, Best Rivet (Special)	9	5	0	,,
,, Cable	9	5	0	,,
,, Screwing	8	5	0	,,

	£	s.	d.	
Best Turning	8	0	0	per ton.
,, Plating	8	5	0	,,
,, ,, Best Best	9	5	0	,,
,, ,, Treble	10	5	0	,,
Plates	7	10	0	,,
Best Plates	8	0	0	,,
,, Boiler Plates	8	10	0	,,
,, Best Boiler Plates	9	10	0	,,
Treble Best Boiler Plates	12	0	0	,,

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon., quote "Star" brand patent wrought nails, steel nails, &c.

Discounts—

45 per cent. off 1-inch to 3-inch strong rose and all fine rose and 6dy. and 8dy. pound.

40 per cent. off 3½ inch to 7-inch strong rose and 10dy. and 20dy. pound.

40 per cent. off all sharp-pointed nails.

Delivered in lots of 4 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis:—
2 tons 9/6 per cwt.
4 cwt. lots and upwards 9/9 per cwt. } d/d any Railway Station.

Steel cut nails, 3-inch basis—
2 tons 8/3 per cwt.
4 cwt. lots 8/6 per cwt. } d/d any Railway Station.
Slit rods (iron) £7 10s. per ton, at works for 2-ton lots.

Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E. C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla, quote:—

	Per Box. f.o.b. Wales. £	s.	d.
Coke Tin-plates.			
C 18¾ by 14 124s. 110 lb. "BV"	0	13	0
C 20 by 10 225s. 155 ,, "Jumbo"	0	18	3
C 20 by 14 112s. 108 ,, "Lydbrook"	0	12	6
C 28 by 20 112s. 216 ,, "Lydbrook"	1	5	3
Charcoal Tinplates:			
C 20 by 14 112s. 108 lb. "Allaway"	0	13	3

BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes:—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

		£	s.	d	
Steel:					
Blooms	at	3	12	0	per ton.
Billets	at	3	14	0	,,
Sheet Bars	at	3	16	0	,,
Finished Steel:					
Bars	at	4	19	0	per ton.
Angles	at	5	0	0	,,
Tees	at	5	3	0	,,
Joists	at	4	10	0	,,
Fencing Standards	at	5	2	0	,,
Shoeing Bars	at	5	4	0	,,
Tyre Bars	at	5	4	0	,,
Half-Round Bars	at	5	5	0	,,
Heavy Rails	at	4	15	0	,,
Light Rails	at	4	17	6	,,

Structural Steelwork:

Prices on application.

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote:—

TIN.

Tin:	£	s.	d.		£	s.	d.	
English Ingots, f.o.b. Dis. 1½% & 1%	132	0	0	to	132	10	0	per ton.
English Bars, f.o.b. Dis. 1½% & 1%	133	0	0	to	133	10	0	,,
Straits G.M.B., cash Warehouse, Net	132	0	0	to	132	10	0	,,
Straits G.M.B., 3 months, Warehouse, Net	130	15	0	to	131	0	0	,,
Australian, Mr. Bischoff, Warehouse, Net	132	10	0	to	133	0	0	,,

COPPER.

Copper:	£	s.	d.		£	s.	d.	
Standard G.M.B., cash Warehouse, Net	67	17	6	to	68	0	0	per ton.
Standard G.M.B., 3 months, Warehouse, Net	68	0	0	to	68	2	6	,,
English, Tough, Cake & Ingot, Warehouse, Net	70	10	0	to	71	0	0	,,
English, Best Select, Warehouse Net	71	0	0	to	71	10	0	,,
English, Sheets and Sheathing, f.o.b., Dis. 2½%	80	0	0	to	80	10	0	,,
English Sheets for India, f.o.b., Dis. 2½%	76	0	0	to	76	10	0	,,
Electro, Warehouse, Net	70	15	0	to	71	0	0	,,
Ore, ex. ship	0	12	0	to	0	13	0	per unit.
Regulus, Matte and Precipitate, ex. ship,	0	13	3	to	0	14	0	,,

YELLOW METAL.

Yellow Metal:	£	s.	d.	£	s.	d.	
Sheets, 4 by 4 feet for India f.o.b. Dis. 2½%				0	0	6⅜	per lb.
Sheathing ,, ,,				0	0	6⅛	,,

SPELTER.

	£	s.	d.		£	s.	d.	
Silesian outports, Net	24	15	0	to	25	0	0	per ton.
Blende of 50 % Net	7	0	0	to	7	10	0	,,
Calamine, Net	7	2	6	to	7	12	6	,,

LEAD.

	£	s.	d.		£	s.	d.	
English Pig, Warehouse, Dis. 2½%	12	17	6	to	13	0	0	per ton.
Spanish, ex ship, Dis. 2½%	12	15	0	to	12	17	6	,,
Lead Ore of 70%, Net	6	12	6	to	6	15	0	,,

ANTIMONY.

	£	s.	d.		£	s.	d.	
Star Regulus, f.o.b., Dis. 2½ %	36	0	0	to	37	0	0	per ton.
Ore, 50 %, ex ship, Dis. 2½%	9	0	0	to	9	0	0	,,
Crude, ex ship, Dis. 2½ %	13	10	0	to	14	0	0	,,

QUICKSILVER.

	£	s.	d.	
Spanish, 75 lb., Warehouse, Net	7	15	0	per flask.
Italian ,, ,, ,,	7	14	0	,,

COAL.

LEICESTERSHIRE.

The Nailstone Colliery Company, Leicester, quote. Price per Ton at Pit of 20 Cwt., with ½ Cwt. per Ton for wastage —

Upper Main Seam.	s.	d.
Main Coal	7	6
Best Hard Steam (hand picked, as used by the Railway Companies)	6	0
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)	6	0
Fine Slack	0	6

Terms, net cash on 10th of month following delivery.

DERBYSHIRE.

The Manners Colliery Co., Ltd., of Ilkeston quote as follows, per ton at pit:

Kilburn Coal:	s.	d.
Best London Brights	9	9
Large Nuts (1½ to 3¼)	9	6
Small Nuts (¾ to 1½)	6	0
Rough Brights	6	0
Peas (⅜ to ¾)	5	0
Slack	3	6
Smudge	2	0

Low Main (or Tupton) Coal:	s.	d.
Low Main Brights	7	6
,, ,, Nuts	7	3
Hards (Good Steam Coal)	8	0
Bakers' Nuts (1" to 2")	6	6
Slack	3	6

The Clay Cross Company's Collieries, Clay Cross, near Chesterfield, quote:—

	per ton at pit. s.	d.
Best Main Coal	10	6
Best Silkstone	10	0
Best House Coal	8	6
Best House Nuts	8	0
Treble Screened Cobbles	7	9
Best Cobbles	7	3

NOTTINGHAMSHIRE.

The Digby Colliery Co., Ltd., near Nottingham, quote per ton at pit:—

Digby Coal:

STEAM.	s.	d.
Best Hand Picked Hard	9	0
Steam Hard	7	9
Hard Nuts	7	0

Gedling Colliery.

HIGH HAZEL.	s.	d.
London Brights, 4 to 8 in. cube	12	0
Large Nuts, 2 to 4 in. cube	9	6
Small Nuts, ¾ to 2 in. cube	5	6

STEAM.—TOP HARD.	s.	d.
Best Hard	9	0
Hard Steam	8	0
Cobbles	7	0

CHEMICALS AND OILS.

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square, Manchester, quote:

	£	s.	d.	
Acids: Oxalic	0	0	2¼	per lb.
Picric, Crystals	0	0	11	,,
Tartaric .... at Manchester	0	0	10⅞	,,

	£	s.	d.	
Acetate of Lime: Brown at Manchester net	9	10	0	per ton.
Grey ,,	11	10	0	,,
Alumina: Alum, Lump, loose	5	5	0	,,
,, ,, in casks	5	7	6	,,
,, Ground, in bags	5	15	0	,,
Sulphate of Alumina, 14%	4	10	0	,,
Ammonia: Carbonate	0	0	3⅝	per lb.
Muriate Grey f.o.b. Liverpool	24	0	0	per ton.
Sal-ammoniac, Lump, 1sts, del^d. U.K.	42	0	0	,,
,, ,, 2nds, ,,	40	0	0	,,
Sulphate .... f.o.b. Liverpool	13	2	6	,,
Arsenic: Best White Powdered ....net	12	5	0	,,
Bleaching Powder, 35% .... ,,	4	10	0	,,
Borax: British Refined Crystal......... ,,	12	0	0	,,

Coal Tar Products:

	£	s.	d.	
Benzole, 50/90 % ,,	0	0	8¼	per gal.
,, 90% ,,	0	0	10	,,
Carbolic Acid Crystals, 34/35° C. ... ,,	0	0	6⅞	per lb.
,, ,, ,, 39/40° C. ... ,,	0	0	7⅛	,,
,, ,, Liquid, 97/99 % ... ,,	0	0	9	per gal.
,, ,, Crude, 62½% at 60° F. f.o.b. ,,	0	2	0	,,
Creosote, ordinary good liquid...... ,,	0	0	1¼	,,
Naphtha, Crude, 20 % at 120° C.... ,,	0	0	8	,,
,, Solvent, 90% at 160° C.f.o.b ,,	0	0	8½	,,
,, ,, 95 % at 160° C. ,, ,,	0	0	9½	,,
,, ,, 90 % at 190° C. ,, ,,	0	0	10½	,,
,, Rectified, flash point over 73° F. ....f.o.b. ,,	0	0	11	,,
,, Rectified, flash point over 100° F. ....f.o.b. ,,		1	0	,,
Naphthalene, all qualities.				
Pitch...............f.a.s. Manchester. ,,	1	12	0	per ton.
Copperas: Green, in bulk .... ,,	0	12	6	,,
,, barrels f.o.b. L'pool ,,	1	19	0	,,
Cake ,,	1	2	6	,,
Copper: Sulphate	22	5	0	,,
Cyanides: 98% minimum ......f.o.b. net	0	0	8	per lb.
Lead: Acetate (Sugar) White, English	27	10	0	per ton.
,, ,, ,, Foreign c.i.f. U.K	24	5	0	,,
,, ,, Grey	21	15	0	,,
,, ,, Brown at Manchester	17	0	0	,,
Nitrate	24	0	0	,,
Litharge, Flake	15	10	0	,,
,, Powder	16	0	0	,,
Red Lead, Genuine, c.i.f. London less 5%	15	10	0	,,
White ,, ,, Dry ,, ,, ,,	16	15	0	,,
Naphtha (Wood): Miscible, 60 o.p.	0	2	10	per gal.
Solvent	0	2	7	,,
Potash: Bichromate... delivered England...	0	0	3	per lb.
Carbonate, 90/92 % ... c.i.f Hull ...	18	0	0	per ton.
Caustic, 75/80 % ...... ,, ,, ...	20	10	0	,,
Chlorate ....net	0	0	3 1/16	per lb.
Montreal.........in Store, Liverpool	35	0	0	per ton.
Prussiate, Yellow ....net	0	0	4 11/16	per lb

	£	s.	d.	
Soda: Ash, Caustic, 48 %, Ordinary ... ,,	5	5	0	per ton.
,, ,, ,, Refined...... ,,	6	5	0	,,
,, Carbonated, 48 %............ ,,	5	10	0	,,
,, ,, 58 % (Ammonia Alkali) ....net	4	10	0	,,
,, Bleachers' Refined Caustic 50/52 % .... net	6	10	0	,,
Caustic, White, 77 %.............. ,,	10	10	0	,,
,, ,, 70 %.............. ,,	9	12	6	,,
,, ,, 60 %............. ,,	8	12	6	,,
,, Cream, 60 %..... .... ,,	8	10	0	,,
Crystals, in bags	3	0	0	,,
,, barrels	3	7	6	,,
Acetate .... c.i.f. Hull net	16	10	0	,,
Bicarbonate, in 1 cwt. kegs............	6	15	0	,,
Bichromate......delivered England...	0	0	2¼	per lb.
Chlorate .... net	0	0	$3\frac{1}{16}$	per lb.
Nitrate ..ex quay Liverpool, ... ,,	11	7	6	per ton.
Phosphate	9	5	0	,,
Prussiate ....net	0	0	3⅝	per lb.
Silicate, Solution, 140° Tw.	4	10	0	per ton.
Sulphate (Glauber Salts)...............	1	12	6	,,
,, (Saltcake, 95%)...............	1	15	0	,,
Sulphur: Recovered	4	15	0	,,
Roll	6	15	0	,,
Flowers................................	7	10	0	,,
Zinc: Sulphate	6	15	0	,,

MINERALS.

	£	s.	d.	
Barytes: Lump Carbonate, 90/92%	3	10	0	per ton.
Sulphate, No. 1, White	2	15	0	,,
China Clay: of various qualities for all purposes; prices from about 11/- to about 30/- per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid.				
Chrome Ore: Basis 50% c.i.f. British Ports..........	3	7	6	,,
Manganese: Lump c.i.f. Liverpool 10¼d.				per metallic unit.
Ochre: French JC .... f.o.b. Rouen, net	2	5	0	per ton.
,, JF	5	10	0	,,
Talc: (French Chalk).........c.i.f. Liverpool	3	10	0	,,

OILS, etc.

	£	s.	d.	
Aniline Oil ....net	0	0	4¾	per lb.
,, **Salt**.......... .... ,,	0	0	4½	,,
Castor Oil: French, 1st pressure, f.o.b. Marseilles less 1¼%.........	23	0	0	per ton.
English, 1st pressure, f.o.r. Hull, less 2½%...............	24	0	0	,,
Cocoa Nut Oil: Ceylon, ex store Manchester...............net	29	10	0	,,
Cochin, ex store Manchester . ...net	32	0	0	,,
Cotton Seed Oil: Refined at Hull, less 2½% naked	12	15	0	,,
Edible...at Hull, less 2½% naked	13	5	0	,,
Glycerine: Crude, 80% .... net	31	0	0	,,
Linseed Oil: Raw... ..at Hull, less 2½% naked	12	7	6	,,
Boiled......at Hull less 2½% naked	13	7	6	,,
Starch: American Pearl...at Manchester, net	9	0	0	,,
Dextrine........... ,, ,,	18	0	0	,,
Farina............... ,, ,,	15	15	0	,,
Shellac: Standard TN orange spot		155/-		per cwt.
March delivery		140/-		,,
Turpentine: American.........at Liverpool	38	10	0	per ton.
Russian ....at Hull...net	18	10	0	

TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote :—

COLONIAL WOODS.

Timber.

		£	s.	d.		£	s.	d.
Quebec Square White Pine...	per cub. ft.	0	1	9	to	0	3	0
Quebec Waney Board Pine...	,,	0	2	8		0	3	9
St. John Pine, 18 in. average	,,	0	2	3		0	3	3
Lower Ports Pine...............	,,	0	1	3		0	1	8
Quebec Red Pine	,,	0	1	6		0	2	0
Quebec Oak, 1st quality	,,	0	2	9		0	3	3
Quebec Oak, 2nd quality ...	,,	0	1	6		0	2	6
Ash	,,	0	1	6		0	2	3
Elm	,,	0	3	0		0	3	9
Hickory	,,	0	2	0		0	2	6
Quebec Birch	,,	0	1	6		0	2	3
St. John Birch	,,	0	1	6		0	2	0
Birch Planks.....................	,,	0	0	9		0	0	11
Spruce Spars	,,	0	0	10		0	1	0

Deals.

		£	s.	d.		£	s.	d.
1st quality Quebec Pine	per std.	22	10	0	to	32	10	0
2nd do. do.	,,	17	0	0		22	0	0
3rd do. do	,,	11	10	0		13	0	0
St. John, N.B., etc., Spruce	,,	6	10	0		6	15	0
Lower Ports Spruce..	,,	6	0	0		6	10	0
Spruce Boards.................	,,	5	10	0		6	0	0

UNITED STATES, etc., WOODS.

Pitch Pine.

		£	s.	d.		£	s.	d.
Hewn	per cub. ft.	0	1	3	to	0	1	8
Sawn	,,	0	0	10		0	1	6
Planks, Stowage	,,	0	0	10		0	1	0
Boards, Prime	per std.	12	10	0		16	0	0
Oak Timber	per cub. ft.	0	1	6		0	2	6
Oak Planks	,,	0	1	6		0	2	1
East India Teak..............	per load	12	0	0		15	0	0
Greenheart.....	,,	6	15	0		7	10	0

EUROPEAN WOODS.

Timber.

		£	s.	d.		£	s.	d.
Riga Redwood	per cub. ft.	0	1	9	to	0	2	3
Dantzic and Memel Fir, Crown	,,	0	2	1		0	2	6
Dantzic and Memel Fir, Middling	,,	0	1	9		0	1	11
Stettin	,,	0	1	9		0	1	11
Swedish...................... ...	,,	0	1	2		0	1	4
Riga Whitewood	,,	0	1	3		0	1	6
Norway Mining Timber	,,	0	0	9		0	0	10
Dantzic and Stettin, etc., Oak..	,,	0	2	6		0	3	0
Norway Spars.................	,,	0	1	2		0	1	9

Deals.

		£	s.	d.		£	s.	d.
Red Archangel and Onega, 1st quality	per std.	19	0	0		21	0	0
Red Archangel and Onega, 2nd quality	,,	16	0	0		17	0	0
Red Archangel and Onega, 3rd quality	,,	12	10	0		15	0	0
St. Petersburg, 1st quality...	,,	16	0	0		17	10	0
Do. 2nd ,, ...	,,	14	0	0		15	0	0
Gefle	,,	14	0	0		17	10	0
Wyburg	,,	12	0	0		13	10	0
Uleaborg	,,	12	0	0		13	10	0
Gothenburg	,,	14	0	0		17	10	0

SELECTED PATENTS.

Compiled expressly for this journal by **Messrs. Page and Rowlingson, Engineering Patent Agents, 28, New Bridge Street, London, E.C.,** and at Manchester.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton Buildings, Chancery Lane, W.C., at the uniform price of 8d.

NEW PATENTS APPLIED FOR.

When Patents have been communicated the names of the communicators are printed in italics.

553. J. H. Boylan, Manchester. Jan. 11th.—Improvements in tubes for steam superheaters and steam generators.

556. F. C. Pulsford, London. Jan. 11th.—Improvements relating to steam heating apparatus.

567. F. K. R Amesbury, London. Jan. 11th.—Improvements relating to internal combustion engines.

569. A. Jaubert, London. Jan. 11th—Improvements in devices for lubricating wheel-hubs and axles, or bosses rotating on shafts and the like.

574. A. R. Green, London. Jan. 11th.—Improvements in or relating to water-gauges for steam boiler or other purposes.

583. C. Ritchie, London. Jan. 11th.—Improvements in and relating to steam and other fluid pressure engines.

594. C. T. Naylor, J. Naylor, and R. Parkinson, Manchester. Jan. 12th.—Improvements in apparatus applicable as a steam generator or water heater or boiler.

597. J. G. Dunlop and T. Bell, Glasgow. Jan. 12th.—Improvements in and connected with turbines.

613. J. Dodds, London. Jan. 12th.—Improvements in valve gear for motive-power engines.

621. H. Schofield and O. P. Macfarlane, London. Jan. 12th.—Improvements in or relating to boiler furnaces or flues.

627. W. H. Barrett and C. C. Cardell, London. Jan. 12th.—Improvements relating to internal combustion engines.

645. I. Klecan and F. Laske, London. Jan. 12th.—Means and method for removing and preventing the formation of scale in boilers.

650. The Honourable C. A. Parsons and C. F. Taylor, London. Jan. 12th.—Improvements in tools for boring and grooving turbine cylinders.

653. J. D. Ewen, London. Jan. 12th.—Improvements in ships' propellers.

657. E. Bitzer, London. Jan. 12th.—Improvements in or relating to flexible metallic pipes and tubes.

668. J. Evans, Wolverhampton. Jan. 13th.—Improvements relating to the admission of steam to and its exhaust from steam-engine cylinders, and to steam cushioning the pistons of such cylinders.

707. T. Drinkwater and G. E. Schofield, London. Jan. 13th.—Improvements in the method of and means for facilitating the examination of steam boilers.

733. W. R. Marshall, Oldham. Jan. 14th.—An improved appliance for natural or forced draught and prevention of smoke in connection with steam boilers and steam generators.

747. A. S. Goldie, Glasgow. Jan. 14th—Improvements in and relating to the furnaces of steam boilers and the like.

750. J. G. Dunlop and T. Bell, Glasgow. Jan. 14th.—Improvements in or connected with steam turbines.

759. G. Cockburn, London. Jan. 14th.—Improvements in isolating and emergency or like valves for steam-pipe connections.

767. F. B. O. Hawes, London. Jan. 14th.—Improved means for controlling the output of fans and pumps.

781. Davy Bros., Ltd., and T. E. Holmes, London. Jan. 14th.—Improvements in steam hydraulic intensifiers.

791. H. A. Ivatt, London. Jan. 14th.—An improved crank shaft for locomotive engines and other purposes.

805. W. Shedden and T. Rowlands, Altrincham. Jan. 16th.—A rotary steam engine and air compressor.

809. D. W. F. Maxwell, London. Jan. 16th.—Improvements in water-tube boilers.

810. P. W. Lockwood, and G. and J. Weir, Ltd., Glasgow. Jan. 16th.—Improvements in and relating to couplings and fastenings for steam-heating tubes and the like.

813. A. Whitlock, and E. Carr, Preston. Jan 16th.—Improvements in heating apparatus boilers.

831. Circulators, Ltd., and H. Schofield, London. Jan. 16th.—Improvements in or relating to steam boilers.

835. E. L. C. Mollard and G. F. Griffin, London. Jan. 16th.—A new or improved apparatus for condensing steam and producing or generating electricity.

852. R. H. Ramsey, London. Jan. 16th.—Improvements in engines.

855. H. B. Boocock and E. H. Boocock, London. Jan. 16th.—Improvements in steam engines and the like applicable for other suitable purposes.

869. M. H. Voigt, London. Jan. 16th.—Improvements in water-circulation devices for steam generators and the like.

875. A. G. M. Michell, London. Jan. 16th.—Improvements in thrust and like bearings.

878. J. Schmidt, E. Busch and A. Lonborg, London. Jan. 16th.—Improvements in or relating to steam engines.

891. H. Orley, Woking. Jan. 17th.—Improved means for facilitating the propulsion of wheels.

907. J. Hopkinson and J. Hopkinson and Co. Ltd., London. Jan. 17th—Improvements in valves and cocks.

935. The Albany Manufacturing Co., Ltd., and F. Lamplough, London. Jan. 17th.—Mechanism for operating the valves of steam engines and the like.

936. J. B. Bowen, Jun., Coventry. Jan. 17th.—Improvements in or relating to internal combustion engines.

939. J. Holms, Jun., London. Jan. 17th.—Improvements in ends for spreaders of draught chains and the like.

944. F. Anderson and J. S. Jarvis, London. Jan 17th.—Improvements in means for fixing tappets to stamp-stems, applicable also to analogous purposes.

957. The Warwick Machinery Co., Ltd., London. Jan. 17th.—Improvements in stop mechanism for elastic fluid turbines. (*The General Electric Co., U.S.A.*)

958. The Warwick Machinery Co., Ltd., London. Jan. 17th.—Improvements in governing mechanism for elastic fluid turbines. (*The General Electric Company, U.S.A.*)

959. H. H. Frost, London. Jan. 17th.—Improvements in or relating to joining of the ends of tubes.

989. A. W. Cooper, Forfarshire. Jan. 18th.—Improvements in turbine engines.

996. C. Russo and G. F. Griffin, London. Jan. 18th.—Improvements in rotary engines.

1,044. P. E. Dowson, Manchester. Jan. 18th.—Improvements in piston rings.

1,092. G. C. Marks, London. Jan. 19th.—Improvements in the guiding means for the plungers of hydraulic elevators. (*W. E. D. Stokes, U.S.A.*)

1,100. H. S. Walker and D. Horsburgh, Manchester. Jan. 20th.—Improvements in steam traps.

1,104. A. Beldam, Liverpool. Jan. 20th.– Improved engine or like packing.

1,108. S. Fox and Hartley and Sugden, Ltd., Halifax. Jan. 20th.—Improvements in cast-iron sectional boilers.

1,115. R. H. Anderson, Newcastle-on-Tyne. Jan. 20th. —Improvements relating to boiler furnace fire-bars.

1,135. E. Colinet, London. Jan. 20th.—Improvements in rotary engines.

1,162. J. W. Mackenzie, London. Jan. 20th.—Improvements in propellers. (*R. W. Shaw.*)

1,185. H Cruse, Manchester. Jan. 21st.—Improvements in joints between the tubes and drums or water tube steam generators.

1,195. J. W. Micklethwait, Gillygate. Jan. 21st.—Railway wagon coupler.

1,204. R. Hutchinson, T. H. Sutcliffe, H. Shaw, and M. Broomhead, London. Jan. 21st. — Improvements in gudgeons and bearings for guide rollers, drums, or the like.

1,210. W. Cassens, London. Jan. 21st.—Method of and apparatus for conducting combustion in boiler furnaces.

1,212. W. H. Muddle, Reigate. Jan. 21st.—An adjustable drill for drilling iron of any description.

1,216. O. G. R. Becker, London. Jan. 21st.—Improvement connected with metal shearing machines.

1,225. E. Dalchow, London. Jan. 21st.—Improvements relating to steam turbines. (Date applied for, Jan. 22nd, 1904.)

1,228. A. Bulling, London. Jan. 21st.—A new or improved method of consuming smoke in stoves, furnaces, and the like. (Date applied for, Jan. 26th, 1904.)

RECENT SPECIFICATIONS.

WATER GAUGES.

J. Hopkinson and Co. Ltd., J. Hopkinson, and R. A. Hopkinson, of Huddersfield. Sept. 21st, 1904.—The invention is directed to new means for attaching the try-tap of a water gauge to the water arm so that the try-tap can be adjusted to any required position, or altogether removed, without breaking or disturbing any permanent joint of the gauge. To the water arm or portion of the gauge by screwing casting or otherwise, is attached a piece constituting a union or practically permanent connection to which the fry-tap is to be attached, the latter having suitable provision for being connected to the union by an internally screwed nut, for example which screws on the try tap and has an internal flange for engaging with a shoulder or collar on the union. A fluid tight joint is formed between the union and the try-tap. The attachment connections may be reversed, the union aforesaid being on the top, aad the nut screwing on ihe gauge body. In a modification the shoulder or collar is dispensed with, and the securing nut is constructed with differential screw threads one set of threads screwing on the try-tap and the other on the gauge body, so that the joint can be made by turning the nut in one direction and unmade by turning it in the other direction.

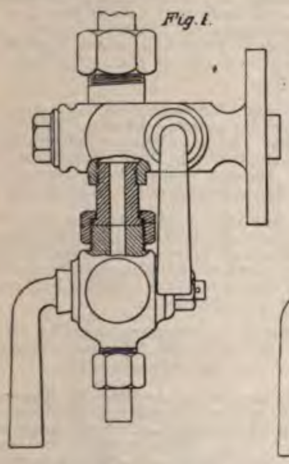


Fig. 1.

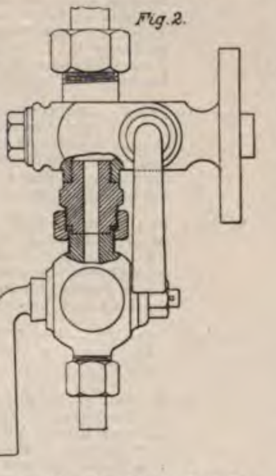
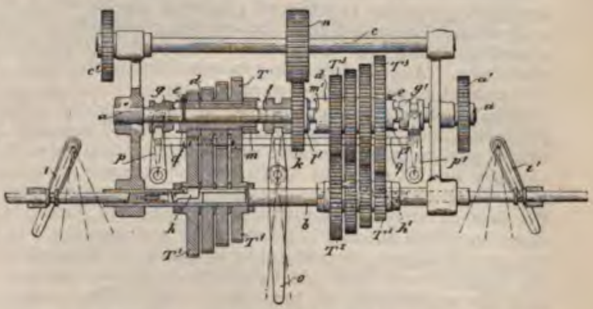


Fig. 2.

VARIABLE SPEED MECHANISM.

Hulse and Co., Ltd., L. E. Adams, and T. M. Lowthian, of Salford. Oct. 12th, 1904.—This invention shows a variable speed driving mechanism wherein each set of two sets of gear wheels can be connected alternatively to a shaft on which they are mounted and to a wheel to be driven and the several wheels of these sets are geared with those of two other sets of change wheels mounted on another shaft and any one wheel of each set of which can be connected thereto at will in suchwise that, at one time, wheels of some of the sets of gear wheels act as drivers and those of others as followers or driven wheels and that at another time, wheels of the sets that were acting as drivers are driven by wheels of the other sets of gear wheels, which latter then act as drivers. When using four wheels in each set as in the example illustrated, a total change of thirty-two speeds is obtained, *i.e.*, sixteen changes when the lever *o* is in such a position that the wheel *n* is clutched to the set T3 of wheels and the shaft *a* is clutched to the set T of wheels, which is then the driving set, and transmits motion through the sets *T1* and *T2* to the set *T3* of gear wheels, and then through wheels *k* and *n* to the shaft *c* and sixteen other changes when the lever *o* is in such a position that the wheel *n* is clutched to the set *T* of wheels and the shaft *a* is clutched to the set T3 which then becomes the driving set and transmits motion through the set T2 and T1 to the set T of the gear wheels and thence through the wheels *k* and *n* to the shaft *c*.



LOCOMOTIVE COUPLINGS.

Fried Krupp Akteingesellschaft, of Essen, Germany. Nov. 15th, 1904. (Date claimed under the International Convention, Feb 16, 1904.) –This invention relates to self-acting couplings for railway vehicles, the object being to provide a coupling in which release can be effected by a single pull, and in which the locking parts of the coupling jaw are mechanically retained in their open or release positions until the jaw has opened, while the parts of the coupling become placed automatically into position ready for again coupling after shunting away the adjacent wagon. The desired ends in view are attained according to the present invention by holding the locking arm (which is employed normally to lock the coupling jaw in its engagement position) in a retracted position and out of action during the time the coupling jaw is being swung into its open position, this being effected by means of a locking lever fitted for that purpose and he eafter described. This locking lever is automatically thrown out of action, and the locking arm thereby released, by the movement of the jaw of the coupling during its motion from its engagement into its open position. The mechanism by which the ends in view are attained is also such that the locking arm, aforesaid is moved aside by the passage of the jaw of the coupling from its open to its engagement position without being locked by the locking lever.

Fig. 1.

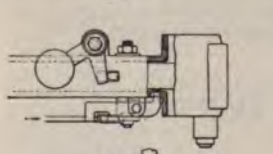


Fig. 4

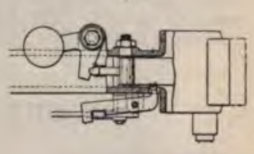


Fig. 3.

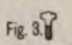
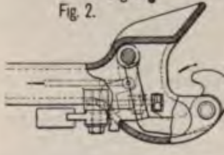


Fig. 2.



NEW PUBLICATIONS.

"A HANDBOOK OF CHEMICAL ENGINEERING."

Illustrated with working examples, and numerous drawings from actual installations. By George E. Davis. Two volumes, Davis Bros., Manchester.

In order to cope successfully with the various difficulties encountered in the practice of chemical engineering, it is absolutely essential that the engineer should have a sound knowledge of advanced theoretical and applied chemistry. Anyone intending to specialise in this direction cannot do better than secure a copy of the second edition of the above exhaustive work, which is fully illustrated, and bears ample evidence of careful revision; this is particularly noticeable in the matter dealing with stresses on beams and struts, wind pressure, vitriol towers and chambers, the strength of cast-iron columns, the flow of viscous liquids through pipes, etc., while a more amplified account is given of the anemometer. In the second volume, considerable attention is devoted to the separation of minerals by electro-magnetic agency, and the application of heat and cold. The author deals with his subject under the following heads: the technical laboratory, materials used in the construction of plant, power and its application, treating and preparing solids, separating solubles from insolubles, evaporation and distillation, crystalisation and dialysis, applications of electricity, organisation and building.

"LOCOMOTIVE INJECTORS."

A handbook on their theory and application, with hints on repairs and management, and historical notes. By "The Inspector." Locomotive Publishing Company, Ltd. 2s. 6d.

A practical treatise for practical men; the author's aim has been to give lucid explanations of the effects on which the injector depends for its action. The subject is treated without the use of mathematics and therefore should prove more acceptable to locomotive men and stationary boiler attendants. From the same publishers we have received an admirable locomotive chart, designed by J. G. Robinson, M.Inst.C.E., chief mechanical engineer of the Great Central Railway. The various parts of the locomotive are numbered and detailed in the drawing, and on making a reference to the corresponding number in the letterpress, it is easy to arrive at the technical designation of any particular part.

BOOKS RECEIVED.

Engineers' Valuing Assistant: being a Practical Treatise on the Valuation of Collieries, and other Mines with Rules, Formulæ, and Examples, also a Set of Valuation Tables etc. By H. D. Hoskold, with an Introductory Note by Peter Gray. Second Edition, Longmans, Green and Co. 7s. 6d. net.

Getting Gold: A Practical Treatise for Prospectors, Miners, and Students. By J. C. F. Johnson, F.G.S. Third Edition. With Fifty Illustrations and Eight Plates. Charles Griffin and Co. Ltd. 3s. 6d.

Fire Tests, with Automatic Sprinklers. Published by the British Fire Prevention Committee.

National Engineering and Trade Lectures, edited by Ben H. Morgan. Volume I., British Progress in Municipal Engineering. By William H. Maxwell, A.M.Inst.C.E. Archibald Constable and Co., Ltd. 6s. net.

Calcareous Cements: their Nature, Manufacture and Uses. By Gilbert R. Redgrave and Charles Spackman. With sixty-three illustrations. Second and Revised edition. Charles Griffin and Co., Ltd.

Mechanism. By S. Dunkerley. M.Sc., etc. With numerous Diagrams. Longmans, Green and Co. 9s. net.

Oil Fuel; its Supply, Composition, and Application. By Sydney H. North With a Folding Plate and 41 Illustrations. Charles Griffin and Co., Ltd.

CALENDARS AND DIARIES.

Messrs. Robert A. Thompson and Co., Ltd., of 5, Tudor Street, E.C., forward a handy pocket diary.

Messrs. John I. Thornycroft and Co., Ltd., have issued a wall calendar which incidentally calls attention to their motors as used for launches, trade vehicles, motor-cars, etc.

From The Quarry, the organ of the stone, marble, slate, lime, clay, and cement trades, we have received a wall calendar, the date sheets of which are printed in red and black. It has also a list of H.M. Inspectors of Quarries, etc.

A substantial and handsomely gilt wall calendar has been issued by Deighton's Patent Flue and Tube Company, Ltd. It furnishes monthly date slips for four years, each of them having interesting illustrations of the firm's productions.

We have also received useful calendars from The Parker Foundry Company, of Derby; Princeps and Co., of Sheffield; B. J. Hall and Co., of 39, Victoria Street, S.W., and Birmingham; The Shannon, Ltd., of Ropemaker Street, E.C.; and Nalder Bros. and Thompson, of 34, Queen Street, E.C.

MEETINGS FOR THE ENSUING WEEK.

FRIDAY, FEB. 3.—Royal Society, 9 p.m.: Lecture by Professor T. Clifford Allbut.—Geologists' Association: Annual General Meeting, University College, Gower Street, 7.30 p.m.—Junior Institute of Engineers, Westminster Palace Hotel, 8 p.m.: Paper, "Recent Developments in Electric Lighting," by Professor H. T. Davidge.—Institution of Electrical Engineers, Glasgow Local Section, 7.30 p.m.: "The Electric Equipment of Automobiles."

SATURDAY, FEB. 4.—Royal Institution, Albemarle Street, W., 3 p.m.: Lecture, Sir Alexander Mackenzie.—Glasgow Technical College, Scientific Society, 7.30 p.m.: Paper, "Cathode Rays and Allied Phenomena," Professor Blyth.—Institution of Electrical Engineers, Glasgow Local Section: Smoking Concert at Grosvenor Restaurant, Gordon Street, 7.30 p.m.

MONDAY, FEB. 6.—Royal Institution, Albemarle Street, 5 p.m.: General Monthly Meeting—Society of Arts, 8 p.m.: Cantor Lecture, "Reservoir Stylographic and Fountain Pen," Mr. James P. Maginnis.—Institution of Electrical Engineers, Newcastle Local Section, 8 p.m.: Durham College.—North-East Coast Institution of Engineers and Shipbuilders.

TUESDAY, FEB. 7.—Royal Institution, Albemarle Street, 5 p.m.: "The Structure and Life of Animals," Professor Miall.—Institution of Engineers and Shipbuilders in Scotland.

WEDNESDAY, FEB. 8.—Society of Arts, 8 p.m.: "Time Development in Photography and Modern Mechanical Methods of carrying it out," Mr. R. Child Bayley.—Liverpool Engineering Society, 8 p.m.: Paper, "Flow of Water in Pipes, Sewers and Channels," Mr. T. Duncanson.—Mining Institute of Scotland, Bothwell Street, Glasgow, 6 p.m. Paper, "The Application of Electrical Power to Mines in Germany," 4 p.m. visit to Mavor and Coulson works.

THURSDAY, FEB. 9.—Institution of Electrical Engineers, Great George Street, S.W., 8 p.m.: Resumed discussion on Messrs. Booth and Kershaw's paper.—Dublin Local Section, Royal College of Science, Dublin, 8 p.m.—Dundee Institute of Engineers: 6 p.m., Paper, "Energy Accumulators," Mr. Andrew Sproul.—Royal Institution, Albemarle Street, W., 5 p.m.

FRIDAY, FEB. 10.—Physical Society: Annual General Meeting.—Royal Society, Albemarle Street, W., 9 p.m.—Royal Astronomical Society, Burlington House, W.: Anniversary Meeting, 5 p.m.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

VOL. VI. LONDON, FRIDAY, FEBRUARY 10, 1905. No. 22.

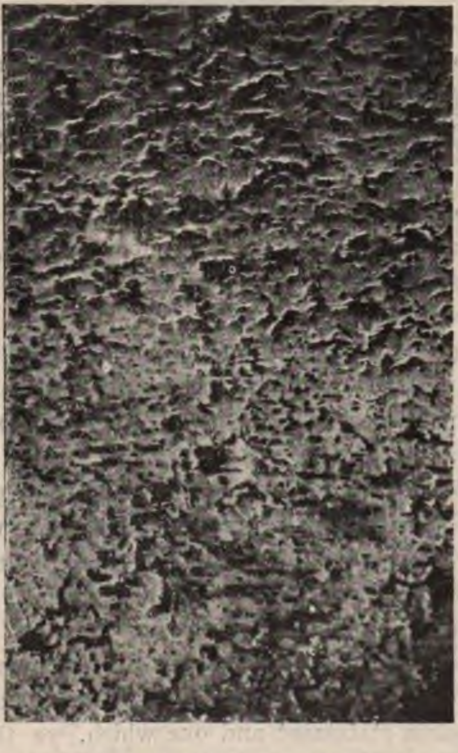
The Offices of "Page's Weekly,"
Wednesday, Midnight.

AN important side issue connected with the report of the Commission on Coal Supplies dealt with elsewhere, is introduced by the following outspoken opinion upon our mining statistics: In the course of our inquiries attention has been drawn to the fact that our mining statistics are inadequate and sometimes misleading. In 1893 the Mining Royalties Commission recommended that the Department of Mines in the Home Office should be reorganised and extended with such additional statutory powers as might be necessary for the purpose of collecting and publishing accurate information with regard to mines and minerals generally, and certain specified matters in particular. In view of that recommendation a Departmental Committee of the Home Office was appointed in 1895 to consider the whole question, and they reported that, although it would be extremely difficult to carry out some of the special recommendations of the Commission, many of them could be adopted at once. The Committee made some further recommendations and suggestions, and pointed out the best methods of obtaining the information desired. Had these suggestions been carried out, say the Commissioners, it would have greatly assisted our inquiries.

The chief objections to the present system appear to be :—

(1) That there is considerable delay in publishing the statistics ;

(2) That information as to important subjects, such as the use of coal-cutting machines and

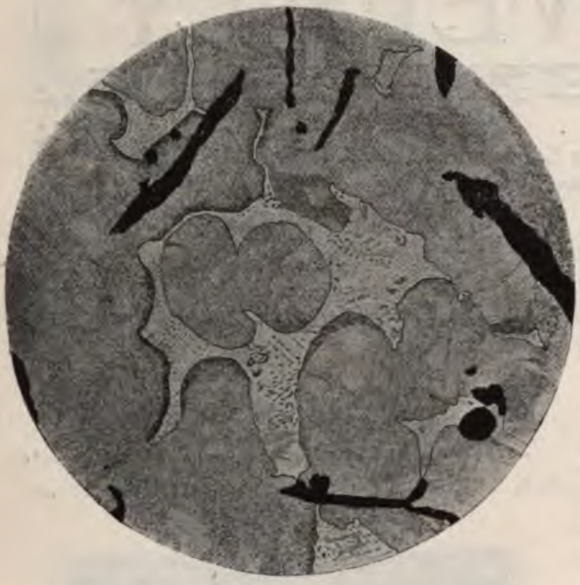


GREY CAST IRON MAGNIFIED 50 DIAMETERS.

Microscopically, cast iron may be regarded as a mass of pure iron distributed through which are varying amounts of impurities. Under a low magnification it does not reveal its ultimate structure, but gives rather a general or bird's-eye view of the structural arrangement as shown above. (*See also page* 280.)

the manufacture of coke and briquettes is omitted, or only occasionally given ;

(3) That, although there is a great deal of information readily obtainable as to the consumption of coal in different industries, no attempt has yet been made to collect and publish it ; and



GREY CAST IRON MAGNIFIED 230 DIAMETERS.

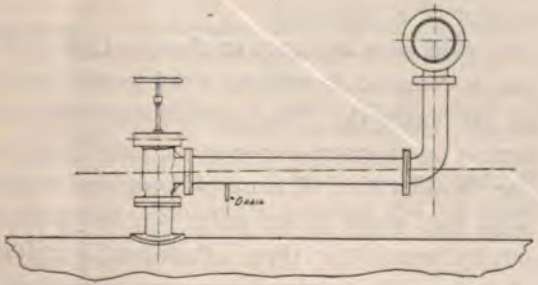
In this photo-micrograph the black streaks and dots of graphite will readily be recognised. The pearlite is laminated in a few places, but the majority of it is granulated in form. The large irregular network in the centre completely enclosing the area of perlite represents the phosphide eutectic.

(4) That much information relating to coal is published by departments other than the Home Office in the shape of Parliamentary Returns, etc.

We venture to think that it would be of great public advantage if accurate information upon the above-mentioned matters were collected and published by one authority, and with greater promptness than at present, and generally we desire to endorse the recommendations of the Mining Royalties Commission.—[A plain statement and one which, we think, needs no further emphasis.]

The report of the Preliminary inquiry **(No. 1,530)** has been issued relating to an explosion from a stop-valve chest at the Soap and Candle Works of the Co-operative Wholesale Society, Ltd., Irlam, near Manchester. In this, the upper part of the cylindrical portion of the cast-iron stop-valve chest fractured around its circumference, and allowed the steam at a pressure of about 58 lb. per square inch to escape from four boilers. The explosion, appears to have been due to water hammer action caused by water lodging in No. 3 junction steam pipe and stop-valve chest, owing to the drain pipe having become choked. The works are supplied with steam from a range of six Lancashire boilers, each 30 ft. long by 8 ft. in diameter, with the usual mountings and saftey valves adjusted to work at a pressure of 60 lb. per square inch. The stop valve on each boiler is connected by means of a junction pipe 7 in. in diameter, 5 ft. 6 in. long horizontally, and about 38 in. vertically, to the main steam pipe, which is 12 in. in diameter internally. There is a ¾-in. drain cock placed about 12 in. from the stop valve end of the junction pipe. This drain leads into a main drain pipe, 2 in. in diameter, and thence to a steam trap at the outside of the range of boilers. As steam is required continuously at the works, the practice is that one or two boilers are laid off for cleaning, while the others are under steam. At the time of the explosion, Nos. 1 and 2 and 5 and 6 boilers were under steam, and Nos. 3 and 4 were opened up for cleaning purposes. On the previous evening three of the Society's workmen were scaling and cleaning the inside of No. 3 boiler, from 6 p.m. to 8.30 p.m., and before going inside, they screwed the stop valve hard down to prevent any leakage of water into the boiler where they were working, and, for further security, locked the wheel of the stop valve in accordance with the Company's instructions.

The explosion occurred at about 6.20 a.m. on the morning after the men had been at work in the boiler. At that time, as before stated, Nos. 3 and 4 boilers were laid off, and a portion of the main steam pipe opposite No. 3 boiler was uncovered and exposed. This is the lowest portion of the main steam pipe, as it rises from here towards the soapery 1 in. in 32 ft., and the conditions were, therefore, most favourable for an accumulation of water to take place at this point, which could only be relieved by the drain on No. 3 junction pipe.



From the evidence of Mr. W. Cheetham, the engineer of the works, it would appea that the drain cock on No. 3 junction pipe was open when he examined it after the explosion. He did not examine the other portions of the drain pipe to ascertain if they were clear, but was under the impression that this drain pipe was choked with sediment in the bend at the lower part of the pipe.

The ¾-in. drain cock on the junction pipe is situated 12 in. from the stop valve. The junction pipe falls 1¼ in. in its length of 5 ft. 6 in. from th stop valve, therefore, it is only reasonable to expect that when steam was not passing, there would be always a small quantity of water lodging at the bottom of the bend of the junction pipe, which the drain could not effectively clear away, but it appears that this unction pipe had before the explosion become full of water during a temporary choking of the drain pipe, and the latter pipe was subsequently cleared by the fluctuation of the pressure in the main steam pipe, due to the opening of three 2-in. stop valves in the soapery end of the main steam pipe by the foreman soap-boiler, who, in his evidence, stated that he was in the act of carrying out this operation when the explosion occurred.

When the stop valve was examined after the explosion, it was found that the fracture extended around the circumference of the chest under the upper flange. The fracture showed that the metal was of good quality and with no indications of any flaws prior to the explosion. It was also noted that the gun-metal spindle was bent about ¼ in. in about 8 in. between the top of the valve and the stuffing-box. This had probably been caused by pressure, owing to the different ratio of expansion between the gun-metal spindle and the cast-iron of the stop valve, and a stress may have been set up thereby upon the cylindrical portion of the chest at the time it received the impact of water, which resulted in the explosion. A new stop valve of an improved pattern has now been fitted, which is designed to allow free expansion of the gun-metal spindle to take place in the stop-valve chest. Arrangements are also being made by the Society's engineer so that a more effective system of draining the water from the steam pipes will be adopted.

The observations of the Engineer Surveyor-in-Chief state that "the explosion appears have been caused by the impact of water on the chest. The drain cock on the steam pipe attached to the chest is said to have been found open after the explosion, it is, however, probable that it, or a portion of the drain pipe, had become choked and thereby led to an accumulation of water, and that the level of this water in the pipe was in some way altered, but how the water was set in motion does not appear to have been ascertained."

The subject of "Gold from Sea Water," which has recently been ventilated in the daily press, might at first sight appear to be anticipatory of what journalists call the "silly season," and one might be pardoned for recalling in connection therewith a certain gentleman, created by Dickens, whose speciality was gold from paving stones. The matter is being seriously taken up, however, and, although Sir William Ramsay, K.C.B., lays particular emphasis upon the fact that the process is still in an experimental stage, he is able to say that nearly one grain of gold may be obtained to one ton of salt water; the actual result obtained being over 2d. per ton of water, which may still further be improved upon by experience. One grain of gold is worth practically 2½d. We are given to understand that the gold can not only be obtained, but that the Snell process can be placed upon an eminently satisfactory commercial basis. The prospect is certainly alluring, except perhaps to the owners of cyanide plants. Beside it, the realisation of the Philosopher's Stone would be a poor achievement. If the investigations referred to had been given on a less authority than that of Sir William Ramsay, there might have been some temptation to take the grain of gold with a grain of salt. Under the circumstances, we can only accept the authority given, and await further details. A general rush for the seaside need not be contemplated, however, for the process is in the hands of a syndicate, and it is scarcely likely that they will send a précis of their method on receipt of a post-card.

If gold were as cheap or cheaper than guano one is tempted to wonder what would become of the currency. The revolutionary effect of such a contingency however we must leave for the consideration of more philosophical minds. That gold exists in sea water was first pointed out by Sonstadt, in 1872. Professor Liversidge, of Sydney, also made a systematic examination of sea water, and his results agree with those of Professor Ramsay.

THE COASTGUARD SCREW STEAMER "SQUIRREL."
Built and engined by Messrs. Workman, Clark and Co., Ltd. The vessel has just completed her trials.
(*See page* 313.)

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

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Clun House, Surrey Street, Strand, London, W.C.
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Telegraphic and Cable Address: "SINEWY, LONDON."

Editorial.—*All communications intended for publication should be written on one side of the paper only, and addressed to "The Editor."*

Any contributions offered, as likely to interest either home or foreign readers, dealing with the industries covered by the Weekly, should be accompanied by stamped and addressed envelope for the return of the MSS. if rejected. When payment is desired this fact should be stated, and the full name and address of the writer should appear on the MSS.

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Correspondence *is invited from any person upon subjects of interest to the engineering community. In all cases this must be accompanied by full name and address of the writer, not necessarily for publication but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

The Editor does not hold himself responsible for the opinions expressed by individual contributors, nor does he necessarily identify himself with their views.

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New Copy for Advertisements,

Alterations, &c., intended for insertion in the current week's issue must be delivered **not later than 4 p.m. on Monday.** If proofs are required the copy and blocks should reach us several days earlier.

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NEWS ITEMS.

Mr. Thomas C. Hutchinson, of the Skinningrove Ironworks, has been elected president of the Cleveland Ironmasters' Association.

Over twelve tons of excellent bituminous coal were raised on February 2nd from the first workable seam at Dover Colliery Works, near the Shakespeare Cliff.

The 58th annual meeting of the Institution of Mechanical Engineers will be held on the 17th inst., at Storey's Gate.

Sir Lowthian Bell, left estate of the gross value of £768,676 7s. 2d., of which the net personality has been sworn at £674,317 8s. 1d.

The London County Council has placed an order for the construction of a new motor fire engine for the use of the London Fire Brigade. While attaining a very high rate of speed, it will be provided with pumps of the latest pattern. The contract price is £1,260.

Presiding as Chancellor at the annual meeting of the Court of Governors of the Birmingham University, Mr. Chamberlain reviewed the progress made by the University since its inauguration, and announced that the Chancellor of the Exchequer had undertaken to propose in the next Budget the doubling of the Government grants for University education.

Messrs. M. Glover and Co., of Leeds, specialists in patent firewood machinery, have been able, in consequence of an extension of their works, to avail themselves of more commodious offices. These are to be found at Low Hall Gateway and supersede the old offices at the Holbeck Works. As far as correspondence is concerned however, it is to be noted that all letters may be addressed as before to Holbeck Lane, Leeds.

Messrs. John Henderson and Co. have established an office at 26, Victoria Street, London, S.W., and we are advised that an engineer or representative will be available at all times for the transaction of urgent and other business in London and district. The registered address for London telegrams is "Cableways"; the telephone number 431 Victoria.

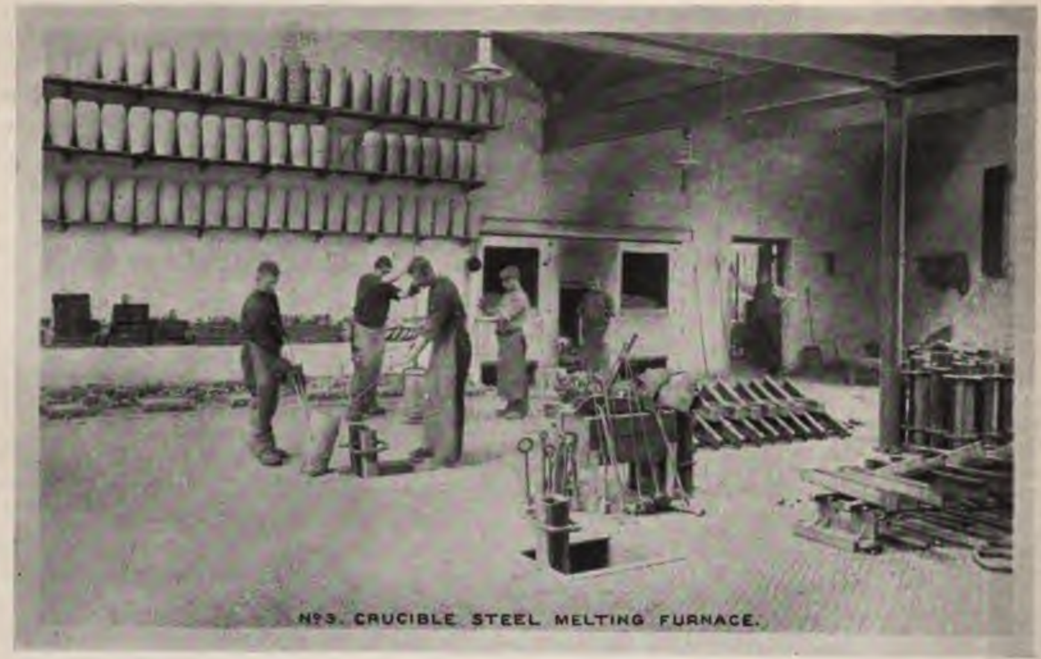
Lord Middleton, in opening the monthly meeting of the Council of the Royal Agricultural Society, announced with much regret the death of their able and esteemed colleague, Mr. James E. Ransome, of Ipswich. Sir Jacob Wilson was appointed honorary director for the 1905 show, in place of Mr. Crutchley, resigned. The stewards for the show were appointed, those for implements being Mr. W. A. Prout, Mr. R. Neville Grenville, and Captain W. S. B. Levett.

Wind-Pressure Gauge and Recorder.

To guard against accidents on the well-known Levens viaduct, the Furness Company have erected an ingenious automatic signalling apparatus. It consists of a combined wind-pressure gauge and recorder, and is connected with an electric arrangement by means of which bells are set ringing in distant signal cabins. These bells will continue to ring so long as the velocity of the wind on the viaduct is dangerous to passing trains, and consequently all traffic will be stopped. A mail train was blown over on this viaduct during a gale in February, 1903. Messrs. Elliott Brothers, who made this apparatus, inform us that it is mounted in a frame built up of steel angles; on two sides of the frame, boards are fixed carried in on hinges and kept normally in the vertical position by means of springs, which are similar in construction to that used in an ordinary steam engine indicator. The strength of the spring is so reckoned out in relation to the area of the board that a pressure of so many pounds per foot can be recorded on the paper chart which is moved by the clock of the recording instrument. Two pens are fitted—one controlled by each board; if the pressure on either board remains constant then the pen will continue to draw a straight line, but an increase or a decrease of pressure will give a deviation of the line at a point on the paper corresponding to the time that this change of pressure takes place.

Institution of Naval Architects.

The annual meetings of the Institution of Naval Architects will be held on Wednesday, April 12th, and the two following days, in the Hall of the Society of Arts, John-street, Adelphi, W.C. (by kind permission of the Council). The Right Hon. the Earl of Glasgow, G.C.M.G., LL.D., president, will occupy the chair. The annual dinner will be held on Wednesday, April 12th, at the Hotel Cecil.



AN ENGINEERING POSTCARD.

The application of the illustrated post-card to business purposes seems to be gaining rapid favour. The latest series to come under our notice has been issued by Messrs. Flocton, Tompkin and Co., Ltd., of Newhall Steel Works, Sheffield. The specimen we have selected for reproduction calls attention once more to the old-fashioned production of high grades of steel by the class of furnace known as "melting holes." Messrs. Flocton, Tompkin and Co., Ltd., are specialising on high-speed air hardening steel, and it is interesting to note that they have extended this form of crucible melting furnace, in the face of all the recommendations of modern furnaces in the shape of gas, etc.

"POWER."

(*A Series of Weekly Notes, continued from page* 224.)

THE water contained in a steam boiler receives its heat from the plates or tubes by conduction, but is almost powerless to pass on the heat to neighbouring particles in this way. For example, if heat be applied to the upper surface of a vertical column of water, local evaporation may be set up, but little or no heat will be communicated to the general body of fluid. Heat is only distributed through the mass of water by convection, which may be defined as "the power possessed by fluids of conveying heat acquired at one place to another place." The difference between conduction and convection may be illustrated thus: imagine a crowd waiting at the box-office of a theatre, or for tickets at a railway station. If the tickets, as fast as they were issued, were passed on from one individual to another until they became gradually distributed throughout the mass—that would be conduction, the method by which heat is propagated by metals and solids. If, on the other hand, each person as he received his ticket, passed on bearing it away with him, and making room for the next person, that would be an exact analogue of the process of convection, the mode by which heat is conveyed in fluids or gases. It will be seen at once that circulation is the essential condition of heat transference through water.

Now, if we take the same tube of water which we have vainly endeavoured to heat from the top downwards, and apply the source of heat to the bottom; provided the heat be intense enough we shall find that the water, unable to part with its heat by conduction at all, and in the absence of any system of circulation, will generate steam at the bottom, and very soon expel the whole contents with violence. The upward and downward currents crowd and jostle each other precisely as two opposite-tending bodies of people would do in a narrow passage, with the result that confusion ensues and the weaker body is driven forth by the stronger. Under the name of "priming" the phenomenon is observable in many steam boilers. Pursuing the analogy one step further, suppose that in the passage a central rail or partition were set up, then the two streams of people would be able to pass each other in an orderly and peaceful manner, and the essential condition of circulation would be achieved.

In a type of steam boiler, less used now than formerly, there were vertical tubes, closed at their lower ends depending from the roof of the firebox. Into each of these tubes, which were only about two inches in diameter, was dropped a small central tube, about 1 in. bore which served the purpose of the rail in the passage and separated the ascending and descending currents. If this inner tube ever became worn out and dropped away from the little tripod which suspended it, the lower part of the outer tube, exposed to the fierce heat, and receiving no water became red-hot and rapidly burnt out. A similar want of circulation, though not attended with such bad effects, may be noticed in boilers with internal flues. In a Cornish or Lancashire boilers the water near the bottom may be nearly cold for hours after the boiler is generating steam above it.

Convection in itself is the effect of gravity. The heated particles rise through the surrounding body of water in virtue of their lessened specific gravity due to expansion. This continues until steam bubbles are formed in the water at the source of heat, when the rate of displacement becomes much more rapid, as the mixed current of steam and water is, of course, still lighter than the heated water alone. Heat continuing to be applied, this formation and projection upwards of steam bubbles becomes more and more rapid, and, provided that circulation is unimpeded, may go on safely without overheating the boiler plates (if the surfaces are clean) even though exposed to the most intense heat.

On the contrary, when circulation is hampered and the rising steam bubbles are unable to get freely away from the heating surfaces, a film or layer of highly heated steam remains in contact with the surface, causing a rise in temperature of the plate, sometimes to a dangerous extent. Should this continue, the plate or tube may become so hot that the water cannot approach it at all, being kept off by the emission of radiant heat. Hutton estimates that the temperatures of a furnace plate from which the water is being repelled in this way, may, within one minute rise to 1,100 deg. F., a condition of imminent danger to the boiler and its surroundings. It being so vitally important to provide facilities for circulation in a steam boiler we may conclude the best of all heating surface in this regard, to be a horizontal plate with water above as the roof of a locomotive firebox, for example, if not obstructed by bridge-stays; and that the worst form—if indeed it can be called heating-surface—is the exact converse of this, namely, with the heat above the water.

NAVAL NOTES.

WEEKLY NOTES ON NAVAL PROGRESS IN CONSTRUCTION AND ARMAMENT.

(BY OUR NAVAL CORRESPONDENT.)

GREAT BRITAIN.

AN inspection of the machinery of the new battleship *King Edward VII.* was held by the Committee of Machinery Designs last week. This vessel is undergoing her commissioning trials in the course of the next few days or so, but the alterations to her furnaces to allow of the consumption of oil fuel will not then be complete. She has already satisfactorily passed through her dynamo trials. The two sister ships, *New Zealand* and *Britannia*, building at Portsmouth, are progressing rapidly. The former is now practically ready for her gunnery and steam trials, all her armament being on board, and the barbettes finally closed in. The *Britannia* is now in dry dock, having her side armour fitted and a large staff of men are at work on her.

The new scout, *Sentinel*, has undergone her steam trials, and made a speed of 25·249 knots with 17,500 h.p., and a moderate consumption of coal. On a special trial for an endurance test, she succeeded in steaming at full speed for nearly ten hours.

A redistribution of the destroyer flotillas in the Mediterranean has been carried out, and there are now five divisions, four based on Malta, and one on Gibraltar. The composition of these divisions is—five vessels forming a working flotilla in commission, a reserve of three vessels, and an additional reserve of one vessel. The main object of this redistribution is to gather together as far as possible all vessels of the same type, in order that the spare parts of the machinery and boilers may be interchangeable, thus reducing the amount of new fittings and parts which each parent ship will have to store.

FRANCE.

The new French Minister of Marine, M. Gaston Thomson, has announced his intention of inculcating a vigorous policy, and he says it is very important that France should have the best types of vessel only. M. Thomson does not come to his duties quite unacquainted with naval matters, as he was reporter on the naval budget for 1899, and was serving at the time M. Rouvier asked him to take the portfolio, as Vice-President of the Extra Parliamentary Committee on the Navy.

Progress with the battleships *Democratie* and *Republique* at Brest has been slow, principally on account of the modifications introduced into the design of the former vessel. The armoured cruiser *Victor Hugo* has had her masts stepped, and she is now in dry dock having her propellers, submerged torpedo tubes, and other under-water fittings placed in position. It is announced that in the battleships of the *Republique* class 7·63-in. guns are to be substituted for the 6.48-in. guns originally prescribed. Further it is stated that all these vessels are to be supplied with large tube Niclausse or Belleville boilers.

JAPAN.

The programme of Naval construction upon which the Japanese Government is about to embark, and which is to be carried out almost in its entirety in the Japanese naval yards is an ambitious one, and the results will be eagerly watched by naval engineers. The actual constitution of the programme has been given in great detail by one newspaper correspondent, and, according to his report, the following is the number and class of vessels to be built:—

One battleship of 19,000 tons and 18·25 knots speed, at Yokosuka; two armoured cruisers of about 10,000 tons at Kure; a number of destroyers and torpedo-boats, and (to be acquired by purchase) fifteen submarines.

The most noteworthy feature about the programme after the enormous displacement of the battleship design, is the armament of the armoured cruisers. It is reported that these vessels are to carry four 12 in. guns, as main armament, and yet are to develop a speed of 20 knots. How this plan will work remains to be seen, but the fact that no other nation has yet ventured to mount four such enormous pieces as the modern 12-in. guns, in one vessel of the armoured cruiser class, argues that either the Japanese have obtained a very remarkable design, such as has not even suggested itself as practicable to European naval architects, or that they will have to modify their plans. It must, of course, be remembered that Japan has two vessels under construction in this country, the *Kashima* and *Katori*, building by Vickers and Elswick respectively.

OLYMPIA MOTOR SHOW.

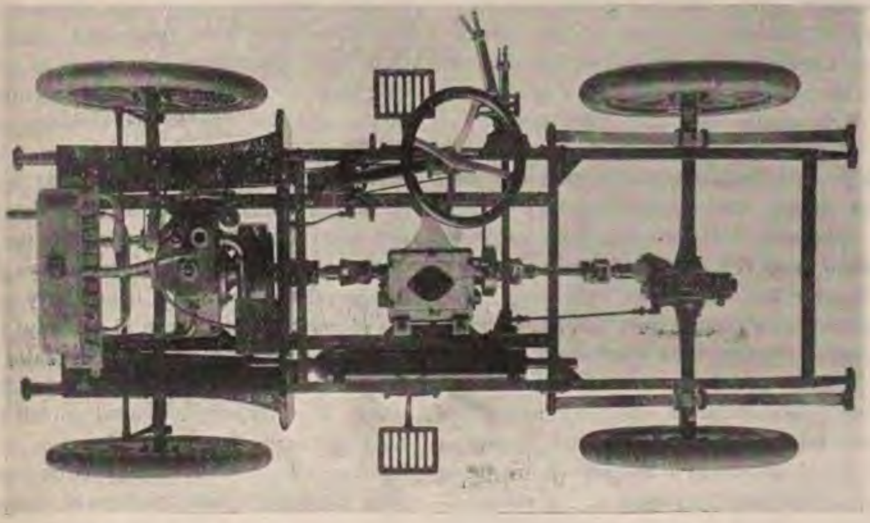
THE great show at Olympia opens to-day, and it promises to be not only representative, but to some extent at least international in character. It may be said, at the outset, that the Society of Motor Manufacturers and Traders, who are responsible for the exhibition deserve that success should attend their efforts for no trouble and scarcely any expense has been spared to give the show a suitable setting. The hall, which is 450 ft. long by 250 ft. wide, has been levelled by the removal of the stage and arena, and a new cement floor has been constructed. This space is devoted to the exhibition of motor-cars, whilst the annexe is being utilised for motor-boats. The gallery, which is 40 ft. wide, and over a quarter of a mile in circuit, contains the exhibits of tyres and accessories. The list of exhibitors is an imposing one, not only in point of numbers, but from the fact that it includes the best known names connected with motor manufacture, and some of the exhibits are of a character which call for detailed notice from the engineering side. In all branches of motor manufacture advances are to be recorded. In particular, the number of firms exhibiting heavy vehicles attracts attention in view of the developments which are taking place in connection with this important branch of traction. Some of the exhibits in this section are of a particularly interesting character, and will be noticed in future issues of PAGE'S WEEKLY, The Brush Electrical Engineering Company, Armstrong, Whitworth, and Co., Ltd., Thornycrofts' Steam Vehicle Company, Daimler Motor Company, Ransome, Sons and Jefferies, and Clarkson, Ltd., are among those represented in this group of exhibits.

In the annexe, where the boat exhibits are housed, the name of Thornycroft is again associated with an important exhibit, while the Wolseley Company, the Mitcham Motor Company, Gaines Reversible Propeller Company, the Neptune Motor Company, and the Simms Manufacturing Company have stands in this section.

The exhibit selected for notice to-day is that of Alldays and Onions Pneumatic Engineering Company, one of the oldest engineering firms in the country.

The illustration below shows the chassis of Alldays' light car. The frame of chassis is of specially light yet strong channel steel. The motor is immediately in front of the dashboard, fixed in a vertical position, 7 b.h.p., and embodies many special features. Transmission is by means of the simple and most satisfactory cardan shaft, through three speeds forward and reverse, change speed gear box, top speed driving direct.

The speeds are changed by means of a sliding movement of gear wheels, operated by *one lever only* for the four gears. The cardan shaft conveys the power from gear box to back axle by means of the well-known and most successful bevel gearing, a steel pinion driving the large phosphor bronze wheel fitted to differential box. The high tension system of electric ignition is used.



CHASSIS OF LIGHT CAR BY ALLDAYS AND ONIONS PNEUMATIC ENGINEERING CO., LTD.

RUNNING-SHED NOTES.

BY J. C. R. ADAMS.

II.

A LARGE and increasing proportion of the engines now built are fitted with cylindrical or bored out guides; but in cases where two or four slide-bars are used it becomes necessary to carefully examine the guiding flanges of the cross-head blocks to make sure that they are not too tightly fitted sideways, in which case, owing to the rapid motion of the cross-head, heating and cutting or abrasion would immediately set in. It is better to err on the side of safety and allow a little side-play. Particular attention should be paid to seeing that the lubrication is directed to the bars upon which the pressure of the cross-head, due to the angularity of the connecting rod, comes; that is, of course, the upper pair of bars if the engine be running "inwards"; and the lower pairs of bars, if it be running "outwards." Cast-iron bars and blocks, made from the same metal, if lubricated properly, soon acquire a hard polished surface, and need no means of adjustment if the wearing surfaces are large enough to begin with.

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It goes without saying that the guide bars must be accurately in line with the bore of the cylinder, and that both must point exactly to the centre of the crank-pin. The axis of the crank-shaft also must be truly at right angles with the centre line of the engine. To check the direction of the axis of the cylinder the cover is removed, and a thin flat steel bar, is fitted diametrically across the bore of the cylinder at each end. One of these bars carries a V-shaped notch, and the other a V-shaped projecting point, exactly like the sights of a gun. The line of sight should, of course, cut the exact centre of the crank-pin. Having thus ascertained that the bore of the cylinder is accurate in direction, the centrality of the piston-rod hole, of the stuffing-box, and of the cross-head hole (or socket in which the piston-rod fits) may be demonstrated in like manner by fitting a little sight-bar into each successively. If the cross-head, while being moved back and forth in its guide bars, deviates neither to the right hand nor to the left, the engine may be considered true, so far.

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The crank, which has been all this time, set with its throw-journal, or crank-pin, furthest from the cylinder, is now turned through half a revolution. If the centre of the pin still remains in the line of sight, it may be taken that the squareness of the main bearings with respect to the axis of the engine is established. But the truth of the crank-throw journal, or crank-pin itself remains to be proved. For this we shall require the connecting-rod. This being put in place with its large end cottered on the crank-pin but with its small end free, will show us, on the crank being rotated, according as the free end travels in a straight line or otherwise, whether the crank-pin is perfectly true, with its axis of the crank-shaft or not.

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Having passed satisfactorily all these tests the engine is now ready for steam. For the ordinary four hours' tests under full load the engine's own flywheel is utilised as a brake pulley, although the rim would soon get uncomfortably hot if encircled by the ordinary brake, for more than a very few minutes. As a matter of practice once the engine has shown its capability of lifting the prescribed brake-load, and the indicator cards have been taken, the brake is removed, and a long lever with a brake-block resting upon a fulcrum, giving about a four-to-one leverage, is put under the flywheel and loaded at the long end to a sufficient extent to give roughly the required resistance. The advantage of this is that the flywheel rim, for the greater part of its circumference is exposed to the cooling action of the atmosphere. Of course, in any test for steam consumption, or where it is necessary to measure the brake horse-power developed for any length of time the flywheel is taken off and a special wheel with deep flanges on the inner circumference of the rim substituted. A water supply is fixed up delivering into this rim, and a small spout is placed so as to meet the rotation, and so, as it were, peel or turn off the solid body of water which revolves in and with the rim of the wheel as fast as it comes in.

ENGINEER'S BOOK OF THE WEEK.

"MACHINE TOOLS AND WORKSHOP PRACTICE."

THIS useful publication deals with a branch of engineering in which new developments are constantly taking place, and the author may serve the purpose of keeping not only the student, for whose use it is primarily intended, but the busy professional man acquainted with the latest methods of workshop practice. One must keep abreast of new developments, and it is common knowledge that the number of machine tools is rapidly being added to, with a consequent change in manufacturing methods, and sometimes, indeed, a radical departure from old systems.

It is true that in the columns of PAGE'S WEEKLY and other technical publications the improvements which are being effected in grinding and milling, and turret lathe work are being constantly dealt with, yet a text book which cements the information on any one subject is to be warmly welcomed. The main object of the book, as expressed in the title, is to explain the construction and use of machine tools in that connected form which long experience of practical work and teaching has proved to be the most suitable.

The most important chapters in the book are those dealing with measurement, turret lathes, grinding and milling, and these have been illustrated in detail. Exact measurement, always of the first importance, is becoming more than ever necessary in modern mechanical workshop practice, owing to the use of interchangeable parts in machine construction. Theoretically, of course absolute accuracy is impossible, and only the close approximation can be obtained, but seeing that the ordinary Whitworth machine measures $\frac{1}{4,000}$ of a millimetre, and the electric micrometer small dimensions and magnitude of the order, $\frac{1}{5,000,000}$ of a millimetre, we have, at least, reached a point in detecting error beyond the capacity of existing machines to correct, and may, therefore, rest content.

The author deals with turret lathes in a long and interesting chapter, selecting for notice the Hartness Flat Die type, the Alfred Herbert Gisholt, Hexagon, the Brass Finishers' and Capstan lathe, and pointing out the advantages of these different machines for varying classes of work. Attention is properly directed, however, to the fact that success in the manufacture of machine tools demanding accuracy depends largely upon methods which will produce better work than the lathe; hence the necessity to finish the work by grinding with emery-wheels in a suitably designed machine. It is obvious, indeed, that the introduction of hardened spindles, bearings, etc., into lathes, milling and other machines, is only made possible by the introduction of suitable grinding machinery, and all engineers realise not only the improvement in the quality and durability of the work thus brought about, but what is of equal, perhaps of even greater importance in these days of strenuous competition, the great saving thus effected in the cost of production. As a matter of experience, some materials, such as soft steel, can be worked to much better advantage by grinding than with the lathe. A satisfactory emery-wheel is a very important factor in the production of good work, but only a good variety of shapes, sizes, and grades of wheels, illustrated in the book, can be trusted to bring out the full possibilities of grinding machinery.

The illustration shows a Universal lapping and grinding machine. The principle on which this machine depends in the lapping out of holes in the use of a series of eccentric spindles. The inner one carrying the grinding wheel is somewhat less in diameter than the hole to be ground, and revolves at a high velocity. This grinding wheel is brought into contact with the surface of the hole to be ground by adjusting the orbit (in which it revolves and which orbit revolves) to the necessary extent, which is accomplished by increasing the eccentricity of the spindles by means of the band wheel, shown in the illustration on fig. 8. These movements are combined with an adjustable vertical reciprocating motion of the whole system of spindles, actuated by the crank-rod and levers (figs. 10, 22 and 24), for the purpose of traversing holes of various depths. The eccentric orbit is adjusted centrally with the hole by means of the transverse adjustment on the head stock (fig. 3), and longitudinal

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"Machine Tools and Workshop Practice," by Alfred Parr, with an introduction by William Robinson, M.E., M.Inst.C.E. With 500 illustrations. Longmans, Green and Co. 10s. 6d. net.

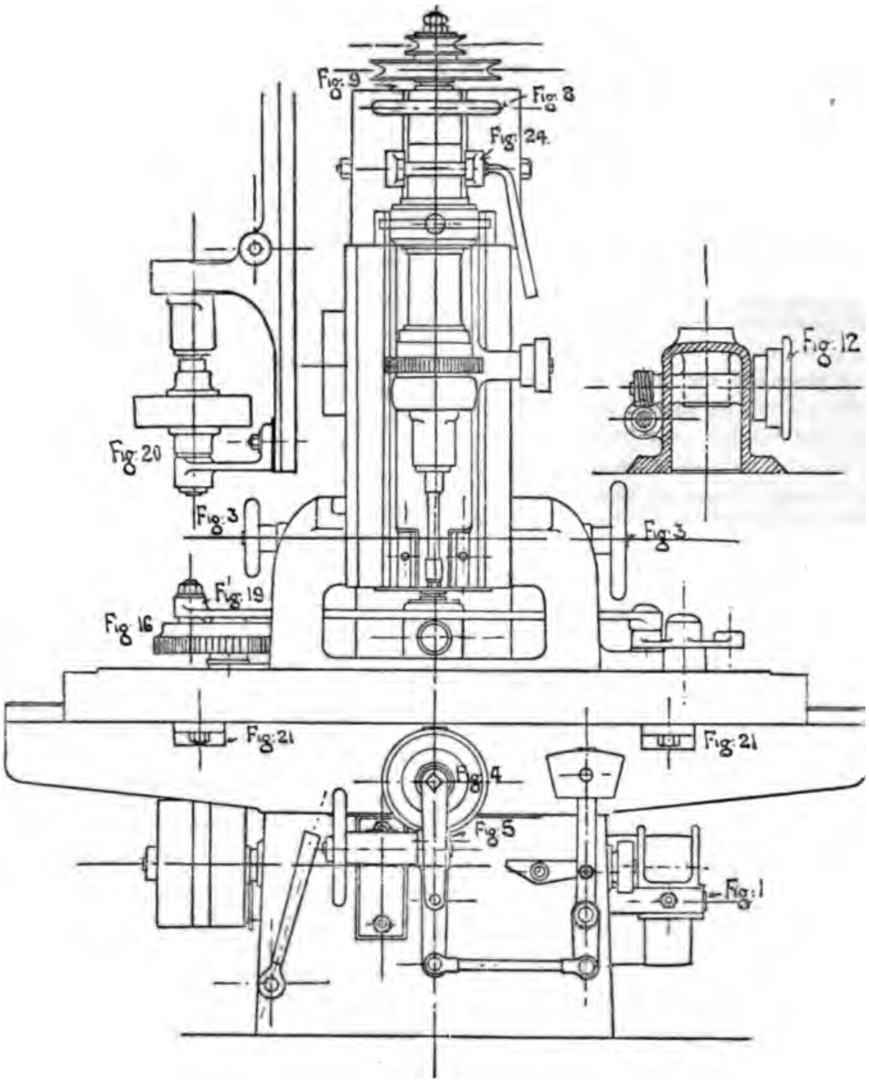

FIG. 1. UNIVERSAL LAPPING AND GRINDING MACHINE.

adjustment on the main table (fig. 4), this table having a fine adjustment with worm and wheel (fig. 5) which is actuated by a clutch (fig. 6). The correct position is found by inserting the grinding wheel in the hole and revolving the main spindle (fig. 7). The feed is obtained by carefully measuring the eccentricity of the grinder spindle by turning the hand-wheel (fig. 8) at the top of the main spindle, which is then fixed in position by the lock-nut (fig. 9). The emery-wheel can be raised by lifting the connecting rod (fig. 10).

The milling machine is not, of course, by any means modern, but it was not until comparatively recently, as readers will remember, that it has become universally adopted as an absolute necessity in all branches of engine construction and machine building trades. The chapter on this subject is copiously illustrated, and will well repay the reader's study. The remainder of the subject matter is arranged under the head of gearing and gear cutters, filing and erecting, vice-work and tool forging processes, and hydraulic machine tools, and the final chapters deal lucidly with transmission of power and methods of working. A good index adds to the value of the work, the compilation of which must have demanded no little skill in the selection of material. To write a comparatively small book on so large a subject, and yet to have included so much, is a task on which the author may look back with satisfaction.

OUR COLONIAL RAILWAYS.

SIERRA LEONE, LAGOS, AND THE GOLD COAST.

THE present position of railway enterprise in British West Africa is summed up in a report drawn up by Messrs. Shelford and Son,* consulting engineers, and included in a return recently presented to Parliament.

An expedition which left England on October 25th, 1893, for the purpose of making a preliminary survey was the first active step taken towards the construction of railways in Sierra Leone. The survey comprised an examination of the route from Freetown *via* Hastings, Waterloo, Songo Town, Rokelle, to Bumban, a distance of some 120 miles from Freetown, the route being that followed by Major Festing during his expedition in 1888 and proposed by him for a railway.

The same party also examined a scheme for a light railway in the Sherbro district from Bonthe to Mina, and thence to Sembahun, near the Liberian frontier.

From the former survey it was evident that a line from Freetown to Songo Town would form a trunk line for all railways in the colony, in whatever direction they might eventually spread over the interior. This portion, 32 miles in length, was accordingly authorised in September, 1895, and construction was commenced in March, 1896. A gauge of 2 ft. 6 in. was adopted for reasons of economy in spanning the numerous ravines traversing the route of the railway.

With regard to extensions from Songo Town, the result of Governor Sir Frederick Cardew's journeys through the colony in the years 1894 and 1895 showed that a more productive country would be tapped by a line to the south of that to Bumban, and upon his recommendations the further surveys of the line were undertaken in an easterly direction *via* Rotifunk, Mano, Bo, and Baiima, towards the Liberian frontier. The extensions have been since carried out in sections step by step, the route finally selected being that shown upon the accompanying map (page 292), accurately as far as Bo, and approxima ely to Baiima.

The following statement gives the date of the report upon each extension of the main line, together with the dates of commencement and completion of each section:—

Section	Distance in Miles.	Reported upon under Date.	Construction.		Remarks.
			Begun.	Finished.	
Freetown — Songo Town	32	13 Aug. 1894	Mar. 1896	Dec. 1898	Difficult country. Eleven large viaducts
Songo Town — Rotifunk	23	22 Nov. 1897	June 1899	Mar. 1900	
Rotifunk—Bo	80	21 Dec. 1899	Dec. 1900	Oct. 1902	
Bo—Baiima	87	28 July 1902	Feb. 1903	—	In progress. 51½ miles completed in February, 1904.
Total	222				

SIERRA LEONE MOUNTAIN RAILWAY.

A suggestion has been made during the administration of Major Nathan, R.E., that residences for officials should be placed upon the salubrious heights above Freetown instead of in the low, unhealthy town at the foot of the hill, and as a result the construction of this line as a steam adhesive railway was authorised in August, 1902. This important local railway is now completed, the opening having taken place on March 1st, 1904. It starts from the terminal station of the main line in Freetown, and, though the length is not great, the difficulties were considerable, there being a large quantity of excavation in hard syenite and laterite, and much work to be done in the streets of Freetown, which are not well adapted to the laying of a railway. The gauge is the same as that of the Sierra Leone Government Railway, viz., 2 ft. 6 in. The gradients are steep, being 1 in 23 for a large proportion of the route. One of the locomotives, by the Hunslet Engine Company, used on this line, is shown in the illustration on page 295.

LAGOS.

In the year 1893 Sir Gilbert Carter, then Governor of Lagos, made an interesting and important journey through the "hinterland" of Lagos, leaving Ebute Metta on January 3rd, 1893, and returning to Lagos on April 4th, having visited Otta, Ifo, Itori, Abeokuta, Eruwa, Iseyin, Oyo, Ogbomosho, Ilorin, Ikerun, Ilesha, Oshogbo, Ede, Iwo, Ibadan,

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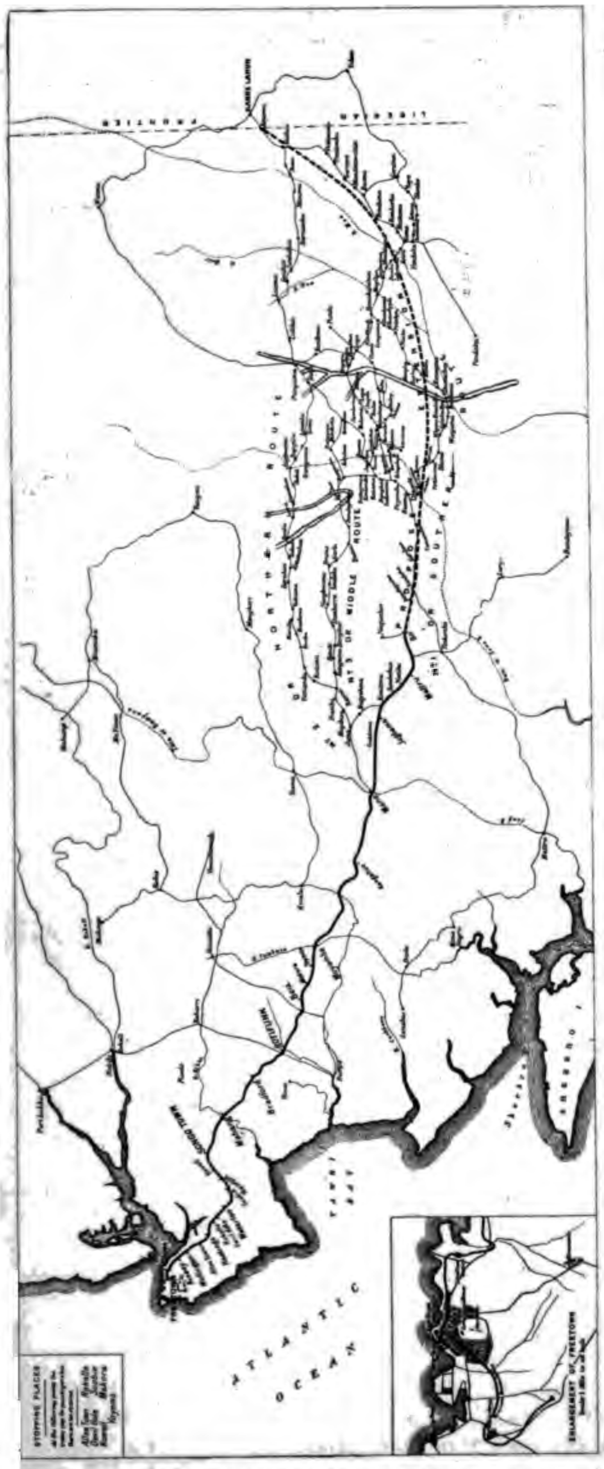
* Since the date of this report, Sir William Shelford, K.C.M.G., has retired from the firm of Shelford and Son, and the business of that firm has been carried out by Sir Benjamin Baker, K.C.B., K.C.M.G., LL.D., F.R.S., D.Sc. (Past President of the Institution of Civil Engineers) and Mr. Frederic Shelford, B.Sc., M.Inst.C.E., under the style of "Baker and Shelford."



MAP OF THE SIERRA LEONE TRUNK LINE.

Jebu Ode, Shagomo, and Ikorodu. The main object of this mission was political, but during the expedition Sir Gilbert Carter paid special attention to the question of railway construction, and eventually stated that there was ample room for encouragement in the prospect of a railway into the heart of the Yoruba country, and he felt sure that such a project should be proceeded with.

As a result of this expedition Mr. W. Shelford, M.Inst.C.E., was instructed to carry out during the dry season of 1894–5 a survey for a railway by alternative routes, and a reconnaissance of the following routes was accordingly made: (1) Lagos to Ilaro *via* Otta; (2) Ilaro to Abeokuta; (2A) Otta to Owowo; (3) Abeokuta to Ibadan; (4) Jebu Ode to Ibadan; (5) Epe to Jebu Ode; (5A) Ejerin to Jebu Ode; (6) Ikorodu to Shagomo. The gauge of railway adopted is that of 3 ft. 6 in., which is in use in South Africa, Australia, and upon the Soudan Military Railway, and can almost be called the Standard Colonial Gauge.

The dates of the authorisation, commencement and completion of the line from Lagos to Otta and subsequent extensions are given below, the railway being constructed *via* routes 1 (part), 2A, 2, and 3 mentioned above.

Section.	Distance — Miles.	Date Authorised.	Construction		Remarks
			Begun	Finished	
Lagos-Otta . ..	20	Dec., 1895	March, 1896	Sept., 1897	Considerable interruptions occurred due to military operations.
Otta-Abeokuta .	44	Dec., 1896	Oct., 1897	April, 1899	
Abeokuta-Ibadan ...	61	23 June, 1898	May, 1899	Dec., 1900	
Total .	125				

The Lagos railway works include the construction of the Denton Railway Bridge from Iddo Island to the main land, it having been decided to place the terminus of the railway upon the Island of Iddo, to which there is a better navigable channel for steamers through the Lagoon than to the main land. A map of the railway is shown on page 294.

CARTER-DENTON ROAD BRIDGES.

It was decided in September, 1895, before the railway was authorised, to construct a road bridge from the island of Lagos across the tidal lagoon to Iddo Island. This is called the "Carter Road Bridge." It is 2,600 ft. in length, and is carried on screw piles over 80 ft. long. The strong reversing currents, depth of mud and ru

which the piles had to be

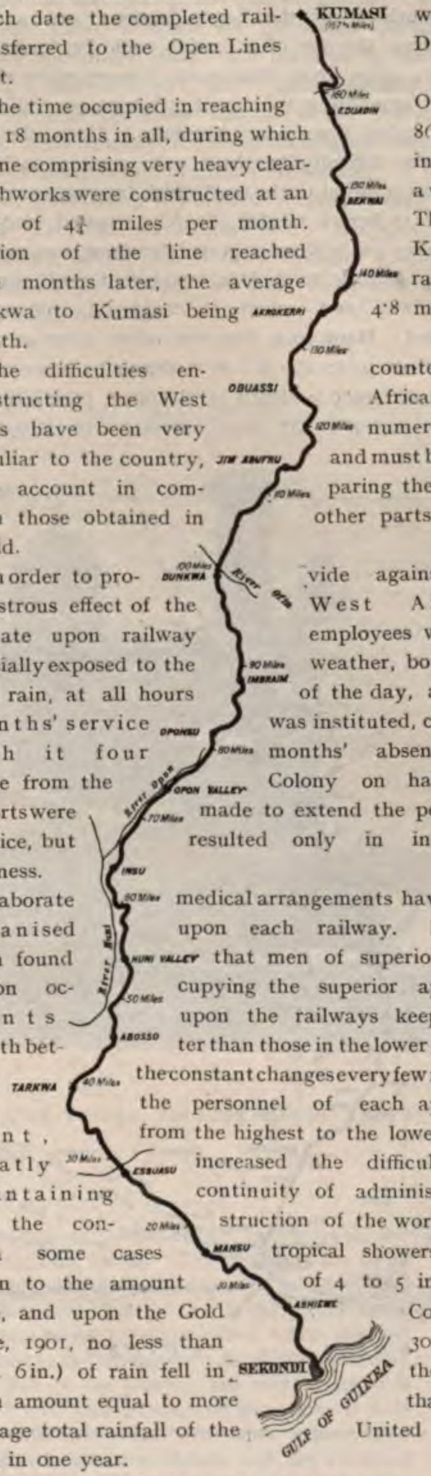
a foundation added to the difficulties of the work. A road across Iddo Island leads to another shorter bridge stretching from Iddo Island to the main land, thus completing the communication. This is called the "Denton Road Bridge," and is 917 ft. in length.

The Carter-Denton Road Bridges have no connection with the railway, which was not authorised until December, 1895. They were promoted by Sir Gilbert Carter, former Governor of the Colony, with a view of affording a much-needed means of communication between Lagos Island and Iddo Island, and thence to the main land for foot passengers, horsemen, and vehicles. The need for the Carter and Denton Road Bridges is demonstrated by the fact that an average of no less than 50,000 persons cross between the island and the main land in a single week, of whom as yet but a small percentage continue their journey upon the railway. The public are sometimes inclined to consider the bridges as a part of the railway, and to include their cost in the cost of the railway. This is an error, as the bridges actually compete with the railway to some extent. Communication between the railway terminus and the town of Lagos is established by means of a 2-ft. 6-in. steam tramway which crosses the Carter Bridge and runs to the doors of the traders' stores in Lagos.

THE GOLD COAST.

The construction of a railway from Sekondi to Tarkwa was commenced early in 1898, but owing to objections to the selection of Sekondi as the port which were pressed very strongly upon the Government, work was suspended until the Secretary of State in July, 1898, held a conference at the Colonial Office with those interested, at which it was decided to adhere to the original proposals, and the actual period occupied in the construction, after the decision that Sekondi was to be the starting point, was 34 months, during which a base with landing jetties, staff quarters, workshops, running sheds, carriage sheds, turntable, etc., was established at Sekondi, a place formerly consisting of a few mud huts, difficult of access, and with no accommodation whatever. This work was carried out in the face of three wet seasons, a prolonged scarcity of labour, and, finally, the Ashanti war.

The Tarkwa-Kumasi extension was authorised on a route which for the first 60 miles or thereabouts was diverted from that which Mr. Fred. Shelford had examined in order that it might serve the Wassau, Abosso, Cinnamon Bippo and other mines, and was begun in June, 1901. The rails reached Obuassi (86 miles) on December 20th, 1902, and Kumasi (128 miles) on September 30th, 1903. The erection of permanent bridges and completion of ballasting were finished to Kumasi on March 31st, 1904, upon which date the completed railway was transferred to the Open Lines Department.



The time occupied in reaching Obuassi was 18 months in all, during which 86 miles of line comprising very heavy clearing and earthworks were constructed at an average rate of 4¾ miles per month. The extension of the line reached Kumasi nine months later, the average rate from Tarkwa to Kumasi being 4·8 miles per month.

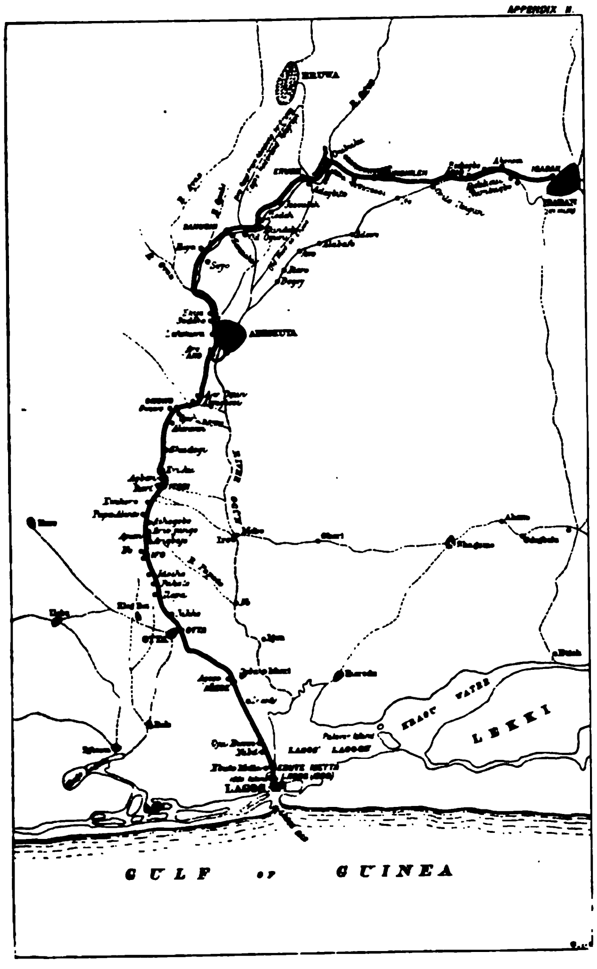
The difficulties encountered in constructing the West African railways have been very numerous and peculiar to the country, and must be taken into account in comparing the results with those obtained in other parts of the world.

In order to provide against the disastrous effect of the West African climate upon railway employees who are specially exposed to the weather, both heat and rain, at all hours of the day, an eight months' service was instituted, carrying with it four months' absence on leave from the Colony on half-pay. Efforts were made to extend the period of service, but resulted only in increased sickness.

Elaborate medical arrangements have been organised upon each railway. It has been found that men of superior education occupying the superior appointments upon the railways keep their health better than those in the lower grades, but the constant changes every few months in the personnel of each appointment, from the highest to the lowest, has greatly increased the difficulty of maintaining continuity of administration in the construction of the works.

In some cases tropical showers have fallen to the amount of 4 to 5 in. at a time, and upon the Gold Coast in June, 1901, no less than 30 inches (2 ft. 6 in.) of rain fell in the month—an amount equal to more than the average total rainfall of the United Kingdom in one year.

This has added greatly to the difficulties of construction. At Sierra Leone, owing to the occurrence of laterite, the difficulty has been little felt; but at Lagos, owing to the alluvial nature of the soil in the neighbourhood of the Lagos lagoons, not a single hard stone the size of a marble could be found until over 50 miles from the coast; consequently all the ballast, amounting to over 2,000 tons per mile, had to be railed from near Abeokuta. Upon the Gold Coast the difficulty has been even greater, as ballast has been essential to the road which traverses a country subject to heavy rainfall, densely forested, and with a soft clay soil. Rock or gravel, however, was reported as very difficult to find in convenient positions near the railway and where it could be economically extracted. Hard rock does not often occur at a less depth than 50 to 100 ft., as is shown by some mining shafts, and such a depth is of course prohibitive for ballast purposes. It was necessary to adopt the expedient of collecting boulders from the bush, by contract with the natives, and breaking them up for ballast. The total amount required for the Gold Coast Railway amounted to some 500,000 tons, and considerable absorption has taken place owing to the necessity for pushing the permanent way over new banks before they had been more or less consolidated by a season's rainfall.



THE LAGOS-IBADAN RAILWAY.

SHIPPING AND LANDING DIFFICULTIES.

Over-carriage of materials, damage to the same, and the loss of ships carrying large consignments of railway materials, have added greatly to the difficulty of providing the materials in proper time and order, especially as it has only been possible to ship small quantities in each steamer in order not to congest the wharves and piers available, or to hamper the shipping company's landing arrangements.

At Sierra Leone the wharf accommodation is extremely limited, though the harbour is otherwise good. At Lagos it is necessary to tranship all cargo at Forcados, some 150 miles beyond Lagos, into branch boats, which return and cross the Lagos Bar. On the Gold Coast at Sekondi all materials have had to be discharged into surf boats and lighters in the open roadstead. The lighterage is in the hands of Messrs. Elder, Dempster and Co., and small consignments have been necessary to prevent delay to the steamers or congestion of the lighterage plant.

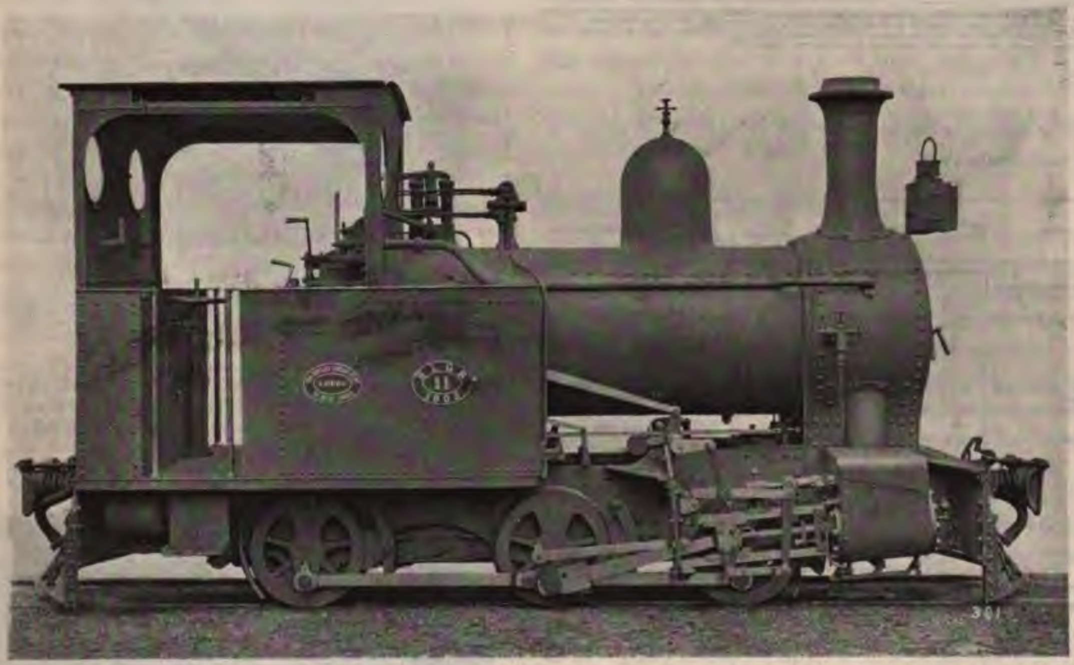
It should be understood that none of the railways have been undertaken as a whole, the work having been carried out in each case tentatively by sections, an interval frequently occurring between the completion of one section and the authorisation of the next, and in all cases the authorisation of the work by sections has rendered impossible an organisation suitable for the rapid construction of the whole. This cautious policy has no doubt been the wisest for each colony to adopt, but has been detrimental to an ever-increasing rate of progress, which would have been realised if from 120 to 220 miles of railway had been undertaken at a time.

The influences militating against rapid progress of railway construction in West Africa are, the want of landing facilities, sickness of staff, and absence of continuity of control due to climate, excessive rainfall, and the physical obstruction of the dense tropical forest rendering survey very slow and requiring heavy labour in clearing, and by the necessity for carrying on the entire work and conveying all the materials from one base.

COST OF CONSTRUCTION.

In considering the cost of the construction of railways in West Africa it is necessary to recollect that they have been carried through dense tropical forest in what is generally recognised as the worst climate in the world, necessitating very short tours of service and constant changes of staff in every grade; with very heavy rainfall; with scarcity and inferiority of unskilled labour and the complete absence of skilled labour; with considerable landing difficulties; and the necessity of carrying on construction entirely from one base, owing to absence of road or path of any description to facilitate the transport of materials in advance of railhead. Further allowance must be made for the native revolts and military operations which have occurred in each case, causing interruptions and disorganisation. The table on page 296 shows the cost of the British West African Government Railways compared with other railways in Africa and in British Possessions.

From these details it will be seen that railways aggregating 522 miles in length have been successfully constructed in the face of the difficulties enumerated, and in the cases of Lagos and Gold Coast with scarcity of ballasting materials.



ONE OF THREE ENGINES SUPPLIED FOR WORKING THE TRAFFIC ON THE SIERRA LEONE MOUNTAIN RAILWAY, WEST AFRICA.

The engines were designed by Messrs. Baker and Shelford, Westminster, engineers for the railway, and constructed by the Hunslet Engine Company, Ltd., Leeds. The cylinders are 9½ in. diameter by 12-in stroke, the coupled wheels 2 ft. diameter, and the wheel-base 7 ft. 6 in. The outside "Walschaerts" valve gear is controlled by reversing gear. The boiler is of steel, with copper fire-box and brass tubes, the total heating-surface being 220 square feet, while the fire-grate area is 4½ square feet. A double spark-arrester is fitted to the smokebox. As it was desirable to keep down the weight of engine and provide only sufficient for one journey, the tank capacity is only of 140 gallons. The working steam-pressure is 160 lb. per square inch, and the engine is fully equipped with modern fittings. It has "Combination" injectors, steam and hand brakes, and vacuum brake for the train, 4 sandboxes, a double-roofed cab, cowcatcher, and the standard central buffers of the Sierra Leone Railways. The weight in working order is 11 tons 11 cwts., equally distributed on the six coupled wheels, and the empty weight is 9 tons 16 cwts.

COST OF THE BRITISH WEST AFRICAN RAILWAYS.

Including Permanent Bridges, Headquarters Establishment, and Rolling Stock, &c., complete.

—	Gauge.	Total Cost.	Length.	Cost per mile.	—
Sierra Leone :—		£	Miles.	£	
1st section	2 ft. 6 in.	193,946	32	6,060	Includes establishment of base and 11 steel viaducts.
2nd section	2 ft. 6 in.	97,164	23	4,224	Impeded by native insurrection.
3rd section	2 ft. 6 in.	319,046	80	3,988	Including permanent steel bridges, additional buildings required by open lines and deviations to eliminate some steep gradients.
4th section	2 ft. 6 in.	348,000	87	4,000	Still under construction; a saving upon the estimate expected.
Total and average ...	2 ft. 6 in.	958,156	222	4,316	
Gold Coast	3 ft. 6 in.	1,753,488	170	10,314*	Accounts not complete at date; a saving is expected. Expenditure upon jetties, piers, seawalls and other harbour works is not included.
Lagos	3 ft. 6 in.	882,961	125	7,064	Includes all capital expenditure to 30th June, 1903.†

* The higher cost of the Gold Coast Railway is due to the difficulties referred to in the text, the heavier works done, and the high rate of wages paid to labourers on the Gold Coast owing to competition with the mining companies.

† The expenditure upon the Lagos Railway, as shown, does not include the cost of the Carter and Denton Bridges, Lagos Steam Tramway, and other works carried out by the Railway Department.

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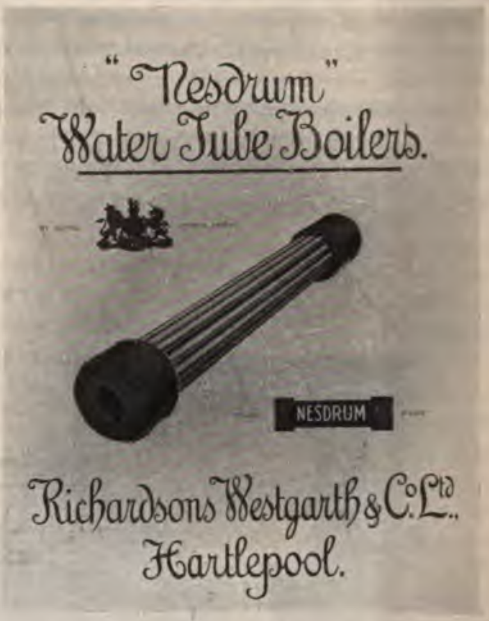
The following table shows the actual rate of progress of each railway:—

Section.	Length Miles.	Begun.	Finished.	Time in Months.	Average Rate in Miles per Month.	Remarks.
SIERRA LEONE RAILWAY (2 ft. 6 in. gauge):—						
Freetown—Songo Town	32	Mar. 1896	Dec. 1898	33	1	Includes construction of headquarters and establishment of base. Difficult country; eleven steel viaducts. Interruption due to native insurrection.
Songo Town—Rotifunk	23	June 1899	Mar. 1900	9	2·6	Mendi rising delayed commencement.
Rotifunk—Bo	80	Dec. 1900	Oct. 1902	22	3·6	Rail laying at rate of five miles per month during part of time.
Bo—Baiima	87	Feb. 1903	Nov. 1904	21	4·1	Progress at date of report is as expected.
	222			85	2·6	Average, including construction of base.
LAGOS RAILWAY (3 ft. 6 in. gauge) —						
Lagos—Otta	20	Mar. 1896	Sept. 1897	18	1·1	Includes construction of headquarters and bridge from island to mainland.
Otta—Abeokuta ...	44	Oct. 1897	April 1899	18	2·4	Delayed by military operations.
Abeokuta—Ibadan ...	61	May 1899	Dec. 1900	19	3·2	Includes terminal work at Ibadan.
	125			55	2·3	Average, including preliminary work at base.
GOLD COAST RAILWAY (3 ft. 6 in. gauge) —						
Sekondi—Tarkwa ...	40	Aug. 1898	May 1901	33	1·2	Includes construction of headquarters and pier. Delayed by scarcity of labour, Ashanti war, and heavy rains.
Tarkwa—Obuassi ...	86	July 1901	Dec. 1902	17	5	Rail laying reached twelve miles per month. Heavy public traffic carried upon railway during construction.
Obuassi—Kumassi ...	44	Feb. 1903	Sept. 1903	7	6·2	
	170			57	3·0	Average, including establishment of new base at Sekondi. N.B.—Very dense tropical jungle throughout.

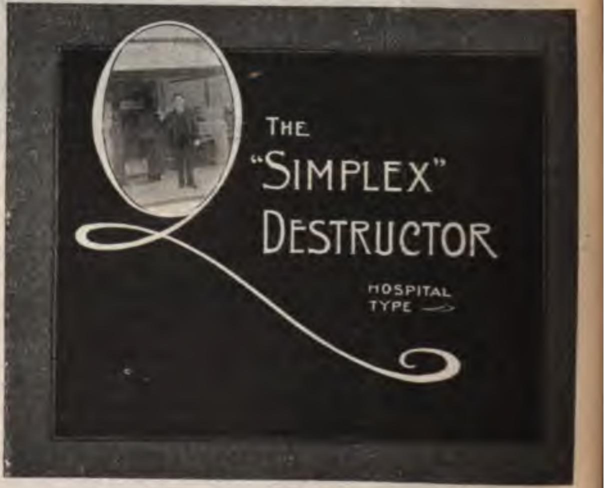
The rate of construction compares favourably with other railways in tropical Africa, with the sole exception of the Uganda Railway, which had the advantage of being authorised and organised as a whole and not in tentative sections.

CATALOGUE COVER DESIGN.

Messrs. Richardsons, Westgarth and Co., Ltd., of Hartlepool, have designed for their "Nesdrum" Water-Tube Boiler Catalogue a cover which is significant and at the same time pleasing to the eye. The type and nest



of tubes are embossed, the latter being rendered in grey and gold, while vermilion, on a rose-pink background, is employed for the script lettering. The pamphlet is tied with a red silk cord.



The lower design shows the simple yet effective arrangement of the cover chosen by Messrs. Meldrum Brothers, Ltd., for their new pamphlet on "The Simplex" Destructor of the hospital type.

MINING NOTES.

Mining Records.

The output of coal in Queensland for 1903 amounted to 507,801 tons, valued at £164,768, being the largest yet recorded with the exception of 1901, when the figures were 539,172 tons, value £180,877.

Statistics issued by the German Iron and Steel Institute show that last year's production of pig iron was the highest on record, the output of all classes amounting to 10,103,941 tons, as compared with 10,085,634 tons in 1903. Coal, lignite, coke, and briquettes showed a large increase over 1903, the former advancing from 116,664,376 tons in 1903 to 120,694,098 tons in 1904.

The twentieth United States Geological Surveys annual report on the mineral resources of the country, containing the statistics for the year 1903, is now available, and shows that the total value of their mineral production exceeded $1,000,000,000. The exact figures were $1,419,721,569, as compared with $1,260,509,738 in 1902—a gain of 12·63 per cent. The value of American iron ore in 1903 was $344,350,000; the value of the coal, $503,724,381.

Gold Mining in Peru.

The mineral wealth of Peru has frequently been the subject of comment in PAGE'S WEEKLY. In a recent number of the Mining Magazine, Mr. Enrique Lavoza calls attention to the wide distribution of gold in that country. As to the hydraulic method of mining, with giants and sluices, which have been so much employed, he says that the most important of the new installations is that of San Antonio de Poto, which in 1903 produced an output of 222,169 lb. In the near future, the hydraulic method will probably convert this neighbourhood into one of the world's principal centres of production. The sands of all the rivers of the eastern slope of the Cordillera carry gold in enormous quantities. During the period of low water, the natives are accustomed to pave the dry river beds with stones; during the high water the rivers cover these stones, depositing particles of gold in the interstices, and when the period of low water returns the Indians collect many ounces of gold nuggets. The production obtained by this rudimentary method in 1903 reached 631·008 lb. troy.

Mica Production.

Though mica is an exceedingly widely distributed mineral, the occurrences of commercial value are exceptional. Out of seven varieties three only have a commercial value, their relative importance being that of the order in which they are named—Muscovite or potash-alumina-mica, Phlogopite or magnesia-mica, and Biotite or iron-magnesia-alumina-mica. Different varieties of Muscovite are distinguished by their colour, and are as follows: ruby, obtained from Bengal, Nellore, the Nilgris, and Brazil; brown obtained from German East Africa; yellow, obtained from Bengal; green, obtained from Nellore, German East Africa, and Brazil; and white obtained from Bengal. Phlogopite is obtained from India, Ceylon, Canada and Brazil. Mica occurs in veins and ordinary mining methods are employed in working it; overhead stoping however, is advocated, as in this case the mica is recovered undamaged by wet. The imports into this country in 1902 were 1,068 tons, and in the succeeding year 1,011 tons, with an average value of £68 and £87 per ton respectively, while the United States for the same years took 878 and 802 tons.

Endless Rope Haulage in India.

The last annual report of the Chief Inspector of Mines in India, states that endless rope haulage is installed at three collieries, viz., (1) at Warora, in the Central Provinces; (2) at Jamadoba, in the Jherria coal-field; (3) at Raniganj. At Warora the tubs are hauled up an incline to the pit bottom only, and are taken up the pit in cages. At Jamadoba the tubs are hauled right up two of the main inclines to the surface and on to the screens. This installation is quite new, and it will be interesting to see how it compares with the usual main rope haulage out of inclines, (1) with regard to the comparative cost, and (2) with regard to the comparative amount of coal which can be raised at one incline per day. It is possible that the endless rope may prove to be the best method of dealing with a large output from one incline. The endless ropes haul out of the side levels as well as up the inclines, the branch being worked off the main rope by clutch gearing. And there are also two landings or attaching points in the No. 4 incline. The tubs are attached to the ropes by means of a simple and effective clip that automatically releases the tubs at the ends of the inclines. The inclination of the seam is 1 in 8, rope speed two miles an hour, and the plough steel wire ropes are 2½ in. in circumference. The driving pulleys are the Thorncliffe clip type, 8 ft. diameter. In the inclines, self acting stop-blocks have been, or are being, fixed at intervals of 50 ft. to arrest any runaway full tub that has from any cause become detached from the ropes.

OUR WEEKLY BIOGRAPHY.

PROFESSOR WILLIAM ROBINSON, M.I.Mech.E., M.Inst.C.E., etc.

PROFESSOR W. ROBINSON, chief of the mechanical and electrical engineering department of the University College of Nottingham, was born at Burt, near Londonderry, December 28th, 1858. He was educated at the Academical Institution, Londonderry, at the Magee College, Derry, and in 1876 he matriculated at Queen's College, Belfast. After two years of study in the Faculté des Sciences, University of Geneva, he completed the three years' course in civil and mechanical engineering at Belfast.

In 1881 he graduated as Bachelor of Engineering, civil and mechanical. At this degree examination he secured first place in the Queen's University of Ireland in the engineering subjects, and also in mathematical physics, chemistry, geology and mineralogy. He was awarded first-class honours, with the gold medal and first Peel prize, and subsequently the senate of the university conferred upon him the honorary degree of Master in Engineering.

After graduation, Mr. Robinson was engaged in practical engineering work in Ireland. In 1882 he became assistant to Professor Perry in London. Before the City and Guilds of London Technical College, Finsbury, was opened in 1883, he was appointed chief assistant in the department of Mechanical Engineering and applied Mathematics. At the end of about two years he resigned his post for the purpose of gaining more experience in practical engineering, and again entered the service of Professors Ayrton and Perry, who, at that time, were carrying on a large practice as consulting and manufacturing engineers. During 1886, with the same object in view, he was engaged by Messrs. Latimer-Clark, Forde, and Taylor, where he had experience in the manufacture, testing, and laying of submarine telegraphic cables. He went on the West African cable-laying expedition, and assisted in the supervision of the laying of various sections, landing and testing the cable after its completion.

In January, 1887, Mr. Robinson returned to the staff of the City and Guilds of London Technical College as senior demonstrator and lecturer under Professor Silvanus P. Thompson, in the Department of Electrical Engineering and Applied Physics.

In July, 1890, he was appointed to the position he now holds as professor of engineering at the University College, Nottingham. He has charge of all the engineering classes of the College, and has arranged systematic courses of instruction in the workshops, laboratories, and drawing office.

In 1890 Professor Robinson published "Gas and Petroleum Engines"—a well-known text-book on the internal combustion engine. He was amongst the first to see in the modern form of petroleum oil engine a handy self-contained and economical prime mover. In 1891 he was awarded a silver medal by the Society of Arts for his lecture giving some of the results of his early researches on the "Uses of Petroleum in Prime Movers"; and at the Society's request he delivered a course of Cantor lectures on the same subject early in 1892. Professor Robinson has devoted special attention to the development of different types of the internal combustion engine, and has tested and reported on many gas and oil engines, petrol engines for motor-cars, gas producers, steam boilers, dynamos, and electric light and power installations. He is often consulted on special questions concerning internal combustion motors by engineers in England, Europe and America.

Professor W. Robinson is a member of the Institution of Civil Engineers, a member of the Institution of Mechanical Engineers, a member of the Institution of Electrical Engineers, and a Fellow of the Physical Society of London.

PROFESSOR WILLIAM ROBINSON, M.I.MECH.E., M.INST.C.E., ETC.

Sir William Preece on the Navigation of the Nile.

THE Nile has been very much in evidence lately, but we have heard a great deal about irrigation and very little about navigation. Mr. William Preece has brought his experience of fifty years to bear upon this important aspect of the Nile question, and his conclusions were stated in the course of a valuable paper contributed last week to the Society of Arts.

Sir William dealt principally with the question of the navigation of the Nile from Assouan to the sea, that is, the regulation of its currents, depth of water, channels, and banks, so that the motion of its boats shall be possible in all times and seasons both up and down stream. The Nile, he says, is virtually embanked from Assouan to the sea. It is practically a canal, and should be treated as a canal. The following paragraphs briefly summarise his views :—

The chief point for careful consideration appears to me to be not only the control of the water, but the control of the silt. Thirty thousand tons of valuable mud are lost in the sea every year, and the rise of the bed of the river in the Delta is a very serious question. Navigation is thus checked, but the remedy is at hand. The outlets are to be cleared by dredging. More sediment will be utilised on the land. Currents will be regulated by storage and barrage. Floods will be under better management. But what is most urgently needed is the protection of the banks, the training of the river, its maintenance in well defined limits, a depth navigable in all seasons, and a call on Nature to assist man to regulate this precious water communication for his daily service.

The principal problem to be solved is how to secure that the Nile shall maintain its own current at a greater velocity than that which causes settlement and so maintain the depth of the river, and how to prevent the increase of this velocity so as to save the erosion of the banks. The Assouan dam has shown how to do it, and the Wadi Rayan appears to be an eligible depression to enable a second reservoir of the same storage capacity to be installed. It is a matter under discussion, and serious objections, geological and financial, have been urged against its adoption ; but let us hope that these objections will disappear under careful scrutiny and survey, for no more eligible position could possibly be secured for such a desirable scheme to supplement the Assouan reservoir, for it would reduce the evaporation difficulty to a minimum.

The works which Sir William considers necessary to improve the navigation of the Nile are thus detailed :—

1. The removal of obstructive banks and shoals. It has been found in the Severn that the removal of shoals (submerged banks) and deepening the bed of the river by dredging has led to a marked increase in the flood discharging power of the river. The navigation has also been greatly improved.

2. The river banks in certain places where they are subject to erosion want to be well pitched to prevent this erosion, and to maintain the proper direction of the current. An admirable system of pitching is to be seen near the landing stage as Asyût.

3. Quays want to be built at all towns where commerce is active, goods are landed, and passengers embark and disembark.

4. Shadûfs and Sakias require to be abolished, especially the former.

5. Training walls are needed to direct currents in useful directions. The following conclusion was adopted by the Seventh International Congress of Navigation at Washington in 1898 :—

"The increase of depth effected by dredging, combined with the rectification of the banks, may, under certain circumstances in the condition of the régime of a river, furnish a satisfactory solution, as shown by the results obtained upon the Severn in England."

6. New lands want to be developed by the deposit of the silt and by the dredging of the river on reclaimed banks and places.

A word as to ways and means :—

The number of boats of all classes plying exceed 22,000. The owners of 22,000 boats would surely submit to a small taxation of £1 per boat per annum to secure better information than they have now, and some attempt at buoying, marking, and beaconing channels.

The Underground Electric Railway Company's Power Station at Lot's Road, Chelsea.

IN a former article we described the new power station at Lot's Road, then in an early stage of construction. By the courtesy of the British Westinghouse Company we are now able to present our readers with views of the completed station, and equipment. It is destined to supply energy for working the whole District Railway system, and also the Baker Street and Waterloo, the Great Northern and Brompton, the Charing Cross and Hampstead, and the Edgware and Hampstead lines. These, in total, amount to over sixty-three miles of track, of which the District Railway supplies about forty, and will unitedly represent by far the heaviest and densest traffic of any electric line. The now practically completed power house contains 60,000 h.p. of generating machinery, covers over 3½ acres of land, including yards, etc., and has cost some two and a half millions of money. The site upon which it stands measures on the water frontage 1,100 ft., and on the Lot's Road side 824 ft.

The size of the building and the plant that it contains have involved the greatest care in laying the foundations, which consist of about 220 concrete piers sunk through strata of made ground, gravel, and sand, to the London clay at a depth of 35 ft.

At the eastern extremity of the site a large barge basin is situated, the function of which is to dock the barges conveying coal or other material to the works. Behind this is the oil cooling plant, and on the western extremity of the site a large bin for containing the furnace ashes before shipment. In the construction of the buildings little less than 20,000 tons of steel have been used, of which some 6,000 tons have gone to the main framework.

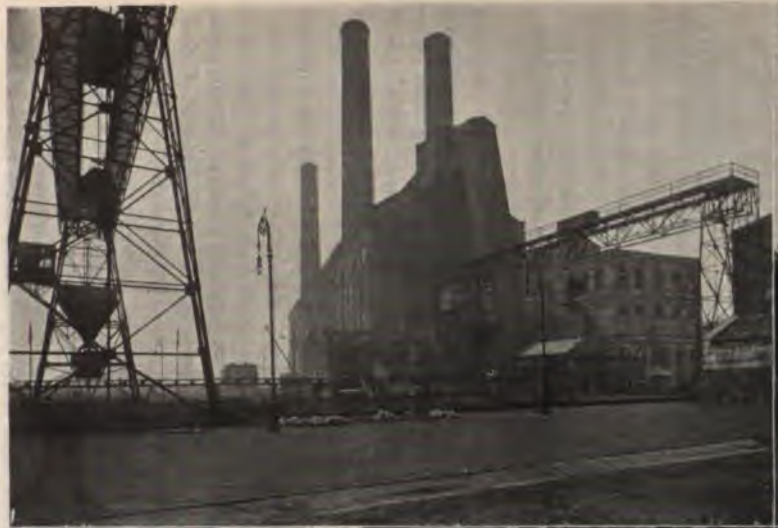
The chimneys, of which there are four, are built on the Custodis principle, with an internal diameter at the base of 19 ft., and a height of 275 ft., and are placed symmetrically, in pairs, in the boiler-house section, about a quarter of the length of the building from the ends.

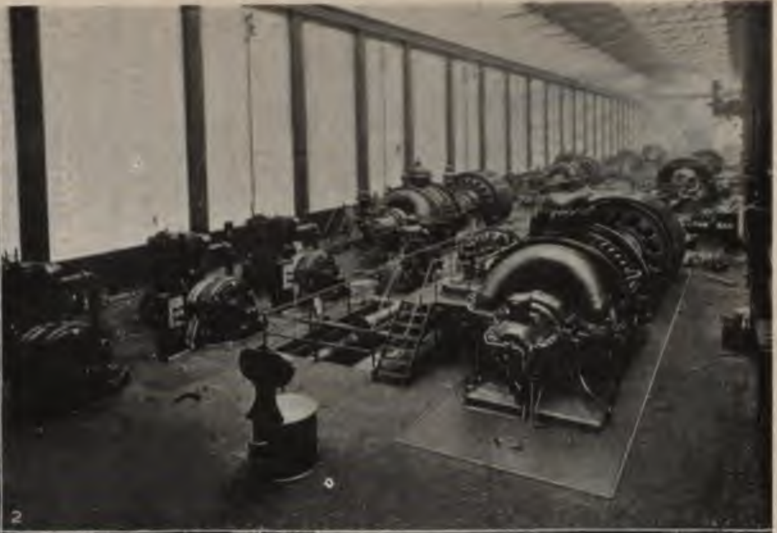
The internal arrangements of the building, which measures 453½ ft. long by 175 ft. broad and 140 ft. high, are shown in cross-section, fig. 5. The coal bunkers are situated on the top floor, the capacity of which is 15,000 tons. As the boilers will consume some 800 tons of fuel daily when the station is in full working order, it is obvious that such a capacity is necessary. The coal is picked up from the barges by two one-ton grab-travelling cranes, and after being weighed is carried by belt and inclined conveyors to the top of the building. Here it is deposited upon another belt conveyor, which is so arranged as to effect its distribution to the several bunkers in any desired quantity. As an alternative to water-borne coal, arrangements have been made to obtain the supply of fuel from sidings of the West London Extension Railway by further arrangements that bring the coal in at the opposite end of the bunkers.

The ashes from the fires are dealt with by self-dumping buckets running on rails laid under the ash hoppers on the ground floor. A storage battery locomotive hauls these to the barges, where they are unloaded by pneumatic hoists. Compressed air is used for sundry purposes, including the operation of the barge basin gate machinery, capstans, and sundry large valves in the power-house.

The boiler-house contains sixty-four Babcock and Wilcox water-tube boilers supported directly on the steel framework of the building, and space is left for the installation of sixteen more. Each possesses 5,212 square feet of heating surface, and is provided with a superheater of 672 square feet area. They are divided up into sets of eight, the number required to operate each turbine unit at full load. There is no steam connection between the various groups, except in one case, where a header for supplying steam to the auxiliaries is fed from two of them. Chain grate stoking gear is provided, with 83 square feet of surface for each boiler. Economisers with 10 ft. tubes are grouped behind the boilers with a by-pass flue, and the total pipe area installed allows 1,540 square feet of feed water heating surface per boiler.

The main steam piping runs down the boiler-house





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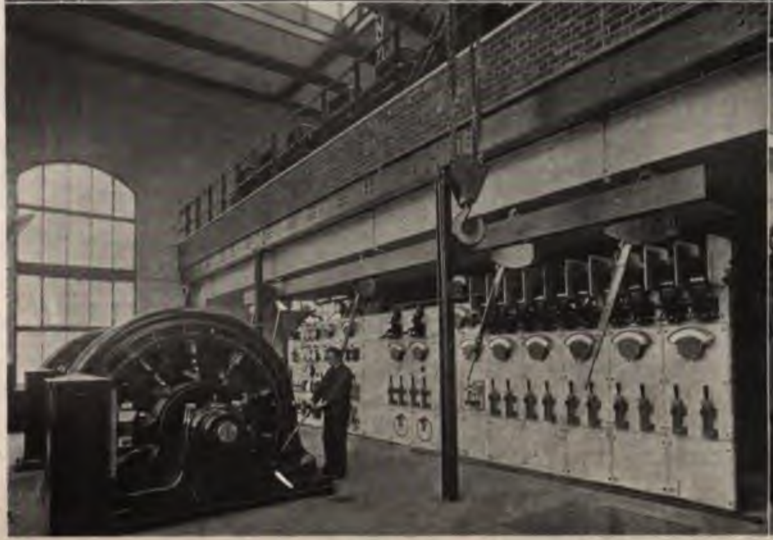

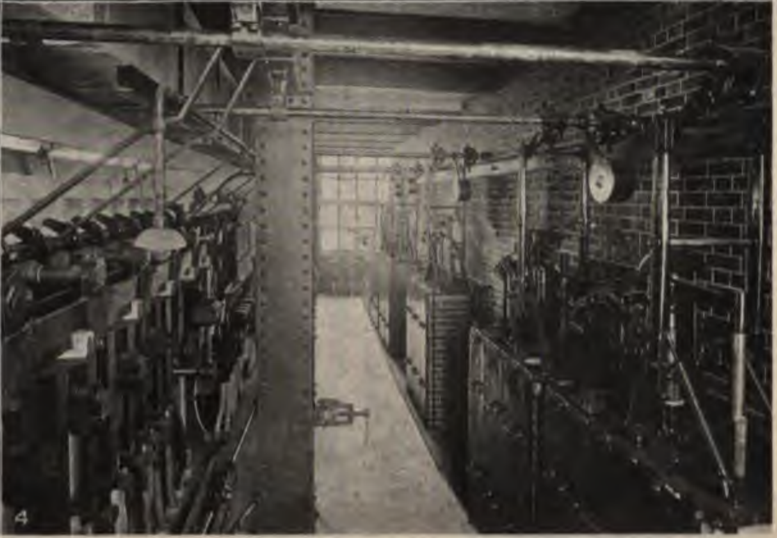

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THE UNDERGROUND ELECTRIC RAILWAY COMPANY'S POWER EQUIPMENT.

(1)—Exterior View. (2)—The Engine Room. (3)—Interior of typical Sub-Station. (4)—Oil Switches, etc., at Hounslow.

side of the dividing wall and under the engine-room floor to the turbines, and is supplied with the usual valves and water pockets.

In the engine-room are installed eight Westinghouse steam turbine generating sets, each consisting of a turbine of some 7,300 b.h.p., coupled direct to a three-phase alternator of 5,500 kilowatts capacity. The former are of the Westinghouse single cylinder, double flow type, and are designed to run with a steam pressure of 165 lb. per square inch, a superheat of 100 deg. F., and at a speed of 1 000 revolutions per minute. They are capable of sustaining an overload of 50 per cent. by aid of automatic by-passes, and are extremely economical in steam consumption.

The three-phase Westinghouse alternators are of the revolving field type and on a non-inductive load will supply a current of 289 amperes per phase at a pressure of 11,000 volts. They are of 5,500 kilowatts capacity, with a frequency of 33·3 per second. The revolving field is a solid forging of Whitworth fluid-pressed steel, of good permeability, and is wound in the usual manner. The armature core of laminated iron is supported by a heavy cast-iron frame, divided horizontally, and is wound in slots on its inner surface.

The four exciter units consist of an Allen-British-Thomson-Houston combinationf and have a capacity of 125 kilowatts at 125 volts when running at 375 revolutions per minute.

The condensers are on the dry vacuum principle, with separate motor-driven air and water pumps. They are installed in pits between the two rows of turbines and have each 15 000 square feet of cooling surface which is fed with circulating water, conveyed through 66-in. pipes from the Thames. The cooling system is based on the principle of the syphon and the 20 in. centrifugal pumps have simply to overcome the friction in these pipes. The condensing equipment was supplied by Messrs. J. H. Simpson and Co.

The switch gear is arranged on three galleries placed principally across the north side of the engine-room. It was supplied by the British Thomson-Houston Company and all the high tension switches are motor-operated by means of a low-pressure circuit controlled from a small pilot switchboard.

The main were supplied by the British Insulated and Helsby Cables, Ltd., and are laid in Doulton stoneware ducts. There are twenty-four substations on the line to each of which a duplicate feeder is run; sixty-four ducts have therefore been laid, which allow for some extension. The feeders are carried through the streets to the Earl's Court station of the District Railway, which is the nearest point to Lot's Road.

The substations of the Metropolitan District Railway supply direct current to the southern half of the Inner Circle, and to a very wide area extending from East Ham to Hounslow and from Sudbury to Wimbledon and Richmond. These points form approximately the bounds of the Company, and are all primarily supplied with power from Lot's Road.

The contract for the whole of the District Railway substations was awarded to the British Westinghouse Company, who are responsible for the design, manufacture and installation of all the buildings and plant.

The British Association.

The South African meeting of the British Association opens on August 15th, the President-elect being Professor G. H. Darwin, F.R.S. Among the presidents-elect of the various sections are: Mathematical and Physical Science: Professor A. R. Forsyth, M.A., Sc.D., F.R.S.; Chemistry: T. Beilby; Geology: Professor H. A. Miers, M.A., D.Sc., F.R.S.; Engineering: Colonel Sir Colin Scott-Moncrieff, G.C.S.I., K.C.M.G., R.E. Lectures have been already arranged by Professor Arnold, on "Compounds of Steel"; Professor Ayrton, on "Distribution of Power"; Professor Porter, on "Mining"; Mr. G. W. Lamplugh, on "The Geology of the Victoria Falls"; and Sir William Crookes, on "Diamonds."

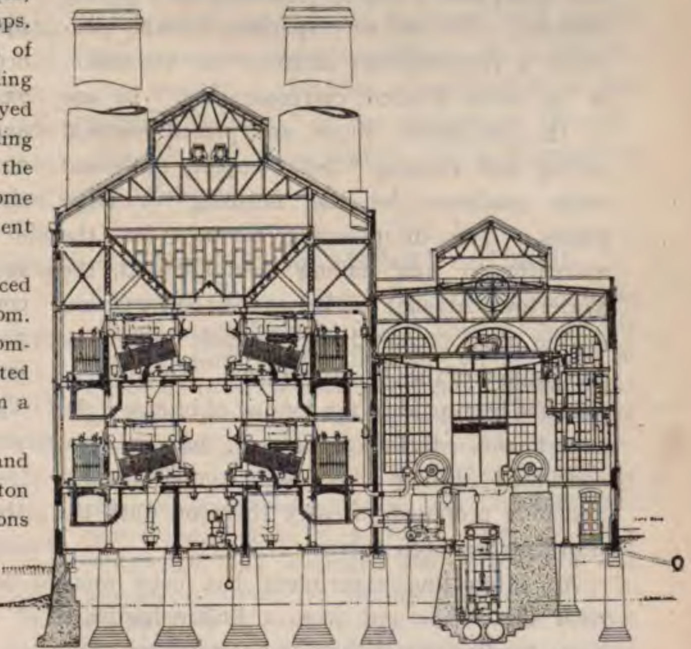
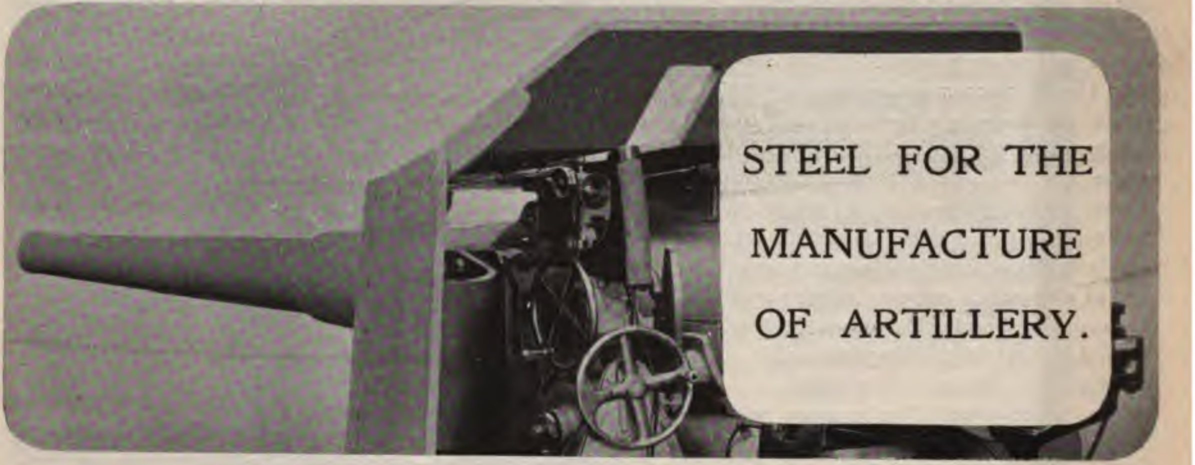


FIG. 5. LOT'S ROAD POWER STATION—CROSS SECTION.



STEEL FOR THE MANUFACTURE OF ARTILLERY.

By Colonel Cubillo (Spanish Royal Artillery).

THE WATERTOWN ARSENAL.

(*Continued from page 235.*)

THIS arsenal, dedicated to the construction of carriages for army artillery is situated in the environs of Boston. The same abundance of space as at Watervliet is observed.

There are foundries and mechanics' shops, and, apart from them, the famous Emery testing machine. The not very spacious foundry possesses a reverberatory furnace for the fusion of the coast defence carriage-pieces. In one of the mechanics' shops are placed vertical boring and turning Niles Company mills and other machines for the finishing of large pieces. The disappearing carriage for the 40-centimetre gun having been adopted, the Watertown Arsenal has begun their construction on the plans prepared by Generals Buffington and Crozier, of the Ordnance Corps. Some attention has been paid to the forging of bronze; the experiments started years ago, having been continued during 1902 with good results, and it is proposed to carry them on until the problem has been solved.

An interesting experiment has been made with thin slices cut from a hollow-hardened piece to discover if their initial tensions could be considered as an exact representation of those of the whole piece. The conclusions arrived at are as follows: 1. The cut slices represent the condition of the metal in the whole piece as regards the internal tensions, and, approximately, their magnitude. 2. The metal in the centre shows an initial compression greater than that indicated by the slice. In the tests this difference was 2·1 kilogrammes per square millimetre. 3. Longitudinal compressions occurred in the centre; they were approximately 75 per cent. of the tangential tensions. 4. The extremities of the tubes, owing to the effect of the longitudinal compressions, took a bell-shaped form. 5. The condition of the metal in the centre of the extremities is less exposed to longitudinal tensions. 6. The run-over concludes with the internal tensions of all kinds. 7. The tension disappeared at 600 deg. centigrade; at 450 deg. half only disappeared. 8. The disappearance of the tension is effected without producing deformations in the pieces.

The Watertown Arsenal has constructed the following carriages during the past year:—

					c/m.
1	Disappearing		Carriage	of	30·5
3	,,		,,	,,	20 0
1	,,	Barbette	,,	,,	30·5
6	Howitzer		,,	,,	30·5
1	,,		,,	,,	25·0
22	,,		,,	,,	18·0

Including the Platforms.

As will be seen, the production is not large, and is not sufficient to mount the guns made at Watervliet, but Midvale constructs what is lacking for coast defence, and the arsenal at Rook Island completes those for field-pieces.

This writer was not permitted to visit the last mentioned place, but it is one of the most important in the United States; as important, if not more, than Watervliet; it employs more workmen, and is not confined to one class of manufacture: harness for artillery, cavalry, and infantry, small arms and rifles being made. The factory turns out 225 rifles daily. In a word, it produces all the materials required by a soldier in time of peace or war.

SPRINGFIELD.

The Springfield small arm factory is situated at Springfield, Massachusets, and presents the same external characteristics as the other national establishments—ample space, well-kept parks, and superb edifices.

The series of reheating furnaces merit special mention. The factory receives the rifle barrels incompletely rolled; they come from Midvale in bundles of about 30 centimetres in length, and are then rolled to the length required at Springfield.

There is nothing out of the ordinary to chronicle regarding the machine work on the barrels, but the excellence of the machines employed, chiefly supplied by Pratt and Whitney. The stocks are made by copying lathes similar to the Blanchard.

A powerful Corliss engine supplies the motive power to the workshops of this section.

At the time of the writer's visit the Springfield factory was preparing for the construction of the new rifle adopted by the United States Government. This rifle, calibre ·30 or 7·6 millimetres, possesses the following ballistic qualities: Weight of ball 14·25 grammes; weight of charge 2·80 grammes; initial velocity 701 metres; velocity at 915 metres, 292 metres; muzzle energy, 362 kilogrametres. The magazine holds five cartridges. Total weight, 450 grammes less than the rifle in use at present.

Springfield turns out two hundred rifles daily, but as this production is not great enough to arm the whole of the army, National Guards and volunteers, in a short time, new workshops are being added to those in existence with the intention of doubling the output. If the 225 rifles per day manufactured by Rook Island are added to this number, the United States Government will be able to count upon 625 per day of eight working hours.

One of the most curious experiments at Springfield has been with a rifle invented by Dr. Cole. The section of the barrel is elliptical 0·30 in. by 0·31 in., and the inclination of the rifling is one turn in 185 millimetres. This rifle was found to be of greater precision than the one in use at distances above 300 metres, The officers on the Committee made further experiments, and then came to the conclusion that the greater precision was not due to the elliptical shape of the barrel, but owing to the inclination of the rifling.

Springfield, like Watervliet and Watertown, takes great care of its workmen, and spends large sums in the prevention of accidents. The wealth of America is manifested in the military factories, in the workshops, the machinery, the offices, and in the appearance of the workmen.

PROFESSOR HENRY ADAMS.

Professor Henry Adams, M.Inst.C.E., etc., who recently retired from the City of London College, has been appointed by the President of the Board of Education to be a member of the Board of Examiners at South Kensington in the engineering group of subjects, and he will act as co-adjutor with Mr. Slater, F.R.I.B.A., in dealing with the subject of building construction. Professor Adams has been for some time examiner to the Society of Architects in building construction and materials, and chairman of the examination committee, superintending examiner to the Institute of Sanitary Engineers, and a member of the Board of Examiners of the Royal Sanitary Institute.

BRITISH COAL.

POSSIBLE ECONOMIES IN PRODUCTION AND USE.

(From the Report of the Royal Commission on Coal Supplies.)

II.

THE MANUFACTURE OF COKE.

IN this industry by far the most important step in recent times is recognised by the Commission to be the introduction of by-product recovery ovens. Whether it will pay to work the by-product recovery process depends first on the nitrogen in the coal recoverable in the form of ammonia, and, secondly, on the volatile matter in the coal recoverable as tar and oils. According to the evidence, 16 or 17 per cent. of volatile matter in the coal probably represents the paying minimum worth of recovery.

In dealing with a coal which is so poor that it will not pay to recover the by-products, a "non-recovery retort oven," is, according to the evidence, the more economical. The yield of coke is good and the ovens are of simpler construction.

It used to be, and sometimes is still, claimed that the old-fashioned Beehive ovens give the hardest, brightest and best coke. The prejudice in their favour is, however, disappearing, and it is beyond question that these ovens are most wasteful, the yield of coke being at least 10 per cent. less than in the case of retort ovens.

The production of coke, as it is extensively carried on in this country, without full utilisaton of the volatile products, was condemned by all the witnesses. In the best modern practice these products are either burnt in flues round the ovens, or are separated by cooling into liquids and gases, the latter of which are used for heating the ovens themselves. The surplus gas can be used for the production of power under steam boilers, or with greater advantage in gas engines. Coke oven gas is a rich gas, approximating to illuminating, and far richer than producer, gas.

Various methods are now adopted for the improvement of the coke from poorer class coals, and also for the coking of coals hitherto regarded as non-coking. The most important of these methods are washing and compression, which have made it possible to coke many coals previously considered useless for coking. Compression has the effect of increasing the output and gives a better and stronger coke. Coal which will not coke in a Beehive oven will frequently do so in a retort oven, and excellent results are obtained from the admixture of a fat or rich coal with a poorer coal. The addition of 5 or 10 per cent. of pitch has also been found to be effective in quick ovens, but this method is too costly for common use.

The importance of the extended adoption of coking, continues the report, cannot be exaggerated. It is one of the methods by which small coal can be rendered marketable. and in some districts it has reduced the waste by furnishing the collieries with an outlet for the small coal, without which outlet it is doubtful whether they could have been carried on.

MANUFACTURE OF BRIQUETTES.

Hitherto this industry has been mainly confined to South Wales, where the small coal made in the screening and in the transit of the best steam coal, is mixed with 8 to 10 per cent. of pitch and converted into briquettes. Large quantities of similar small steam coal are exported to the Continent for the same purpose. Of the value of these briquettes as fuel there is no doubt, and they are extensively purchased by the Royal Navy as a reserve stock in hot climates, where they are said to deteriorate less than Welsh coal. In England and Scotland briquettes are seldom made, probably because there is a good market for small coal. There is, however, every reason to anticipate that in the future, they will be more largely used for steam and domestic purposes, and there appears to be a good field for the discovery of a suitable binding material; pitch, which is the chief binder at present being rather too smoky for domestic purposes, and also high in price.

The evidence points to the conclusion that a suitable briquette plant, if well managed, should pay in connection with a colliery; at present the briquette factories in this country are mostly situated at, or near docks. Suggestions have been made that partial distillation, in addition to washing and cleaning, would give a much wider choice of material for the manufacture of first-class briquettes, and that coal and oil might be used in combination so as to form briquettes of good calorific value out of inferior coal.

Summing up this section of the evidence the Commissioners opine that seams which cannot now be worked at a profit, will in the future be rendered profitable by washing, sorting, coking, briquetting the coal, or converting it into gas, and that no small coal need be left in the mine. It has been proved that large quantities of the best Welsh steam coal are left underground in the form of " small," solely because under present conditions it does not pay to bring it out. It appears that much of this " small," although it is frequently dirty, is of similar quality to that now made into briquettes in South Wales, and we look to washing and briquetting as one of the available methods by which such coal can be brought out and sold to advantage.

ECONOMIES IN TRANSPORT FROM THE COLLIERIES TO THE USERS THROUGHOUT THE UNITED KINGDOM.

A few witnesses suggested that the rates charged in some districts for the carriage of coal are unreasonable. Whether that be so or not, the Commissioners will not attempt to say without a full inquiry into the circumstances, but the opinion of other witnesses was that the railway rates in this country generally were not unreasonable having regard to all conditions.

It was suggested that the use of larger wagons and engines would effect a saving both to the Railway Companies and to the colliery owners, but it was admitted that large wagons would not be applicable to the whole coal trade, and in many cases would involve costly alterations in the pit-head arrangements Even if these suggestions were carried out it does not follow that there would be any material reduction in the cost of transport.

The evidence points to a future extension of central power stations, and the generation and transmission of power upon a large scale. If such stations were established in close proximity to the collieries, there would be nothing to pay on the coal in the way of railway rates, and the question would then be, not the cost of the transport of coal but the cost of transmission of power.

Canals are but little used in this country for the conveyance of coal. The evidence shows that this is partly due to shortness of water and partly because the railways afford a more direct, rapid and convenient means of transport. The Aire and Calder Canal has, however proved of great advantage to the Yorkshire coalowners, especially for their shipping trade, and on the Continent in recent years great developments of the canal systems have been undertaken with a view to affording cheap water carriage.

ECONOMIES IN USE.

Coming to the vastly important subject of economies in use, the Commissioners draw particular attention to Mr. Beilby's interesting calculation that out of an annual consumption of from 143,000,000 to 168,000,000 tons of coal in this country there is a possible saving of from 40 to 60 million tons. How these economies may be effected, and the difficulties standing in the way of their extensive adoption, are indicated under several heads, the first being concerned with the production of power.

COAL WASTED IN STEAM RAISING.

Mr. Beilby has estimated that about 52 million tons of coal are annually converted into steam power at mines and factories in the United Kingdom, and it is generally agreed that the consumption of coal per i.h.p. per hour is on an average about 5 lb. When it is stated that the consumption of coal per i.h.p. per hour should not exceed 2 lb., and might even be less, the waste and extravagance of our methods of raising steam will be realised. It is true that improvements and economies have been going on, especially during the last twenty-five years, and according to the evidence there is now very little hope of improvement upon the best type of modern steam engines; but it is said that if all steam engines were as efficient as the best, 50 per cent. of the coal now used for steam raising might be saved. The use of oil and gas engines is increasing, but for greater economy we must look to the general installation of central power stations.

It is beyond question that collieries are extremely wasteful in the consumption of coal, and it was stated by one witness that if the whole of the plant of the collieries in the kingdom were modern plant of the best description, the consumption of coal would be one half of what it is to-day.

FURTHER SUGGESTED ECONOMIES.

The witnesses stated that a more extended use of economisers, automatic stokers, and mechanical draught is desirable for greater economy and a careful and systematic analysis of chimney gases and of the ashes from the furnace was advocated. Important results have been obtained by superheating the steam on its way to the cylinder and economies can be effected by the extended use of exhaust steam for heating purposes.

Considerable waste now goes on through boiler incrustations, owing to the use of hard water for raising steam. Mr. Maurice Deacon stated that an incrustation from half to three-quarters of an inch thick caused a loss of 20 per cent. in power. He strongly advocated the use of water chemically purified, but especially the use of condensers as the most economical and effectual manner of producing good boiler water.

The Hon. C. A. Parsons stated in evidence that steamers fitted with turbines give superior speed and less coal consumption for the same speed. There seems to be no limit to their size, but with a small power, say under 200 h.p., they cannot be worked so economically.

	Tons of Coal remaining unworked in Seams of Coal which are :				Total Estimated Quantity of Coal remaining unworked.	Estimated Quantity not capable of being worked due to Barriers required to be left or for support of Surface Buildings, &c.				Loss in Working due to faults and other natural causes in Seams of :				Total Estimated Deductions due to all the foregoing causes.	Estimated net available Tons remaining unworked.
	Inches. 12 to 15.	Inches. 15 to 18.	Inches. 18 to 24.	Inches. 24 and upwards		Inches. 12 to 15.	Inches. 15 to 18.	Inches. 18 to 24.	Inches. 24 and upwards	Inches. 12 to 15.	Inches. 15 to 18.	Inches. 18 to 24.	Inches. 24 and upwards		
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
DISTRICT A.															
South Wales & Monmouthshire	1,479,204,119	1,671,732,990	3,260,164,500	27,031,798,830	33,442,000,330	84,079,665	115,509,504	175,726,518	1,562,704,977	224,976,416	228,491,934	483,830,497	4,096,684,249	6,972,003,700	26,470,996,579
Somersetshire and part of Gloucestershire								No details.							4,198,301,000
Forest of Dean	29,529,125	64,064,228	66,173,275	146,161,512	305,928,137	1,290,749	1,635,147	2,236,875	3,533,710	3,043,424	6,624,484	7,163,852	21,866,449	47,394,690	258,533,447
DISTRICT B.															
Stafford (N.)	9,196,402	42,061,632	167,083,818	5,048,501,222	5,267,833,074	332,095	2,121,987	8,632,801	362,264,291	757,640	3,368,439	13,163,642	509,141,832	899,782,727	4,368,050,347
Stafford (S.)	46,972,039	72,617,293	72,760,926	1,759,277,177	1,951,627,435	3,873,550	8,182,230	9,737,197	112,386,911	8,552,943	15,621,967	14,571,989	365,253,276	538,179,363	1,413,448,072
Warwick	10,700,111	16,122,837	14,279,289	1,407,702,319	1,448,804,556	430,245	829,486	1,016,657	62,684,315	1,836,957	2,814,503	2,379,146	249,831,444	321,822,653	1,126,981,903
Leicester	42,446,584	56,826,676	99,887,118	2,289,412,827	2,467,583,205	1,082,609	1,282,588	1,562,907	81,001,111	12,748,321	15,812,046	34,791,691	493,863,181	642,134,654	1,825,458,551
Shropshire	12,617,826	26,872,408	21,180,006	308,503,380	369,174,620	—	1,064,050	1,175,439	8,966,388	841,785	2,076,034	3,109,599	30,947,626	48,180,921	320,993,699
DISTRICT C.															
Lancashire	186,451,024	206,122,247	392,721,612	4,504,249,544	5,349,554,437	4,108,961	7,383,851	15,917,265	220,955,775	33,882,284	48,740,170	61,596,103	718,462,301	1,111,046,710	4,238,507,727
Cheshire	18,418,985	16,702,875	28,906,250	294,971,162	358,998,172	69,328	54,000	315,000	5,834,257	3,284,663	2,742,084	5,228,832	49,637,737	67,165,901	291,832,271
N. Wales	31,228,275	45,061,851	152,404,652	2,284,343,322	2,513,026,200	256,250	835,589	2,910,186	89,627,383	4,768,890	8,720,530	29,276,404	640,163,139	776,558,371	1,736,467,829
DISTRICT D.															
Yorks.								No details.							19,138,006,386
Derby & Notts								No details.							7,360,726,100
DISTRICT E.															
Northumb'rl'nd	186,030,600	257,371,255	549,590,786	6,046,755,486	7,040,348,127	18,752,273	21,462,257	34,154,555	279,078,448	18,758,141	25,055,028	59,349,161	1,074,112,623	1,530,722,486	5,509,625,641
Cumberland	24,460,123	6,456,500	177,466,298	1,980,556,809	2,188,938,830	192,150	301,425	1,842,578	21,019,139	2,347,030	1,004,880	39,879,527	594,643,296	661,230,025	1,527,708,805
Durham	260,121,298	201,823,880	659,553,337	5,486,201,898	6,607,700,522	43,480,542	16,493,235	85,729,432	653,448,709	19,423,167	15,517,141	43,901,632	458,590,318	1,336,584,176	5,271,116,346
DISTRICT F.															
Scotland	1,908,725,991	1,758,264,440	2,503,443,245	15,089,333,985	21,259,767,661	192,943,128	214,030,846	267,238,228	1,792,717,841	261,492,960	238,771,945	359,137,030	2,252,979,327	5,579,311,306	15,680,456,355
DISTRICT G.															
Ireland								No details.							174,458,000
														Total	100,914,898,167

TOTAL AVAILABLE COAL RESOURCES OF THE PROVED COALFIELDS OF THE UNITED KINGDOM, NOT EXCEEDING 4,000 FEET IN DEPTH.

For many years a large amount of experimenting has been done with a view to the discovery of some process for burning fuel in the form of an impalpable powder—the idea being to feed the furnace with a blast of air and the fine powder, which will burn like sprayed oil or a gas jet. This process is reported to have found favour in Germany, and to have been largely used in Berlin.

The use of forced or induced draught furnaces is extending and the results obtained are said to be good. Large quantities of small and inferior fuel have thus been used, which otherwise must have been cast aside as useless.

Much has been done in the last twenty-five years, but from the foregoing facts it is clear that there are still immense economies capable of realisation in connection with the raising of steam.

BLAST FURNACE GAS.

In this country an enormous quantity of waste gas is made in blast furnaces, of which insufficient use is made at present. Some idea of the value of this source of power will be given, when it is stated that the estimated amount of waste gas is equivalent to 1,000 h.p. for every 100 tons of pig-iron made, and that the estimated potential power of this waste gas, if it were utilised for power purposes, would displace and save 2 to 3 million tons of coal annually—on a moderate estimate. Most of the difficulties in making suitable engines and in purifying the gas seem now to have been overcome, and the initial cost of an installation is stated to be approximately the same as that of a good steam plant, but the evidence points to a great opportunity of utilising a source of power which has hitherto been practically wasted.

COKE OVEN GAS.

The value and waste of coke oven gas have already been referred to in connection with the manufacture of coke. It is difficult to estimate the amount of potential power from this source, but it has been calculated that, assuming that an oven is carbonising at the rate of 7 tons a day, the waste gas from such an oven would be equal to about 40 h.p. in a gas engine.

MANUFACTURE AND USE OF GAS FOR GAS ENGINES.

Gas engines are now established as the most economical of heat motors, and it is said that if the average steam engine and boiler installation of to-day, with its average consumption of 5 lb. of coal per h.p. hour, were entirely replaced by gas producers and gas engines the 52 million tons of coal, which it is estimated by Mr. Beilby are consumed for power purposes at mines and factories, would be reduced to 11 million tons. The possibility of this enormous economy seems to be established by the results of many trials by which it is proved that power can be generated by gas engines in almost any locality and on almost any scale with the consumption of 1 lb. of average slack per i.h.p. per hour. The general introduction of gas engines and the use of producer gas could not therefore fail to have an important effect upon our coal consumption.

PRODUCER GAS PLANTS.

According to the witnesses much economy of fuel results from the use of producer gas plants, but this depends on several conditions, especially their size and their load factor. The fullest economy is obtained in large plants of 4,000 h.p. and upwards with recovery of by-products, in which case the cost of the coal is balanced by the value of the by-products; without recovery of the by-products it does not pay to put down plant for bituminous coal of less than, say 100 h.p. It would be difficult to exaggerate the importance of the development of these gas-producing processes, which are said to have rendered practicable the utilisation of inferior coal, and have thus enormously increased the available resources of the country.

WATER GAS.

It is in evidence that water gas is a very convenient fuel, if it is possible to obtain an ample supply of suitable coke at a sufficiently moderate price. Compared with producer gas, it has from 2 to 2½ times the calorific power, and being practically undiluted with inert constituents, it can be distributed in smaller pipes.

POSSIBLE SUBSTITUTES FOR COAL.

Under this heading the Commissioners considered: (i.) alcohol; (ii.) natural gas; (iii.) oil; (iv.) water power; (v.) windmill power; and (vi.) peat. They are convinced that coal is our only reliable source of power, and that there is no real substitute. There are, however, some possible sources of power which may slightly relieve the demand for coal.

PRODUCTION AND TRANSMISSION OF POWER.

Before passing away from possible economies in power production, the Commissioners refer to the savings which the witnesses anticipate from the increase of central stations for the generation and production of power in bulk. The success already attained by such stations in America, on the Continent, and in the United Kingdom makes it appear probable that in towns the smaller consumers will in the future obtain a large proportion of their power in this way. It is also said that central power stations scattered over the country wherever a source of power is available, be it coal, water, peat, or waste gas, will attract to themselves large users of power.

For all purposes where it is necessary to transmit power over a distance, electricity is now rapidly coming into use, and it is estimated that the annual production of electricity in this country is already something between 500 and 600 million Board of Trade units. According to the evidence, with an ammonia-recovery plant a unit of electricity can be produced at about ·13d. per kilowatt hour working with a gas engine, not including interest and rent, and hopes are entertained that the cost may be still further reduced even to ·10d.

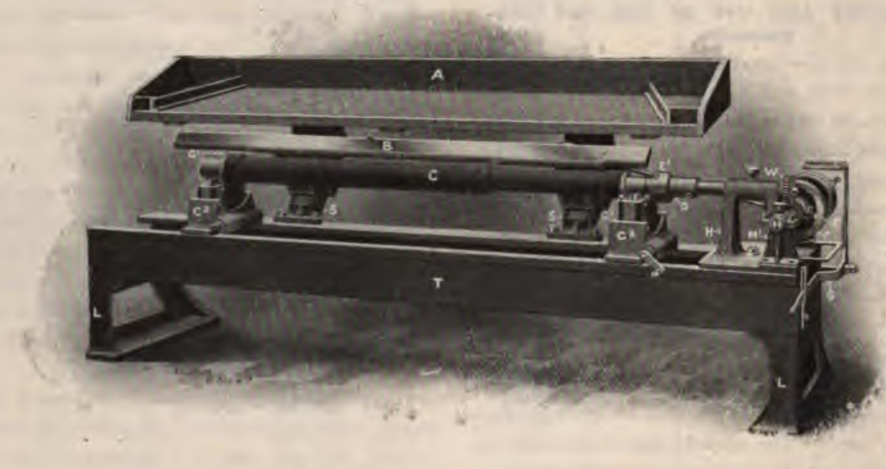
The Commissioners also deal with possible economies in the production of heat and light,

AN ADVANCE IN CORE-FORMING.

THE usual method of making cores for light pipes *i.e.*, rainwater, soil, or hotwater pipes, with metal ⅛ in. to ⅜ in. thick, is with hinged core boxes, the moulding sand being ground and prepared for the purpose. A square bar of iron runs through the full length to support the core when lifted from the core box to the mould; but it requires much skill and considerable practice, and the core when made is fragile and easily damaged. The method for heavy pipes, ½ in. to 1 in. thick, and 4 in. to 48 in. diameter, is to strike up the core with a board, first winding hay or wood wool rope round the core barrel (a tube running the full length of the core), and covering this with clay wash or loam, in which horse hair, etc., is used as a binding material. It is a slow, cumbrous and dirty operation, and the carting away of the residue accumulating under the loam boards is a source of waste and expense.

The machine illustrated herewith has been designed by Mr. W. Jones to make a better core in less time, with unskilled labour, at half the cost, and it is suitable for thick or thin pipes from 2 in. to 20 in. diameter. It may be described as a core turning lathe, but instead of cutting metal off a revolving bar as in an ordinary lathe, the steel bar, about 11 ft. long, fixes (by its reciprocating motion) the sand on the core barrel as it revolves, thus making a perfectly true core with ordinary moulding sand, the thickness of the sand varying from ¼ in. thick on a 2 in. core barrel, to ¾ in. thick on a 12 in. core barrel.

The machine consists principally of the lathe bed, 13 ft. long, two adjustable carriages for carrying the core barrel, the headstock with driving spindle for revolving the core barrel, and a steel reciprocating bar shaped to suit the required core, which is driven by an eccentric from the main driving shaft. All the



THE JONES PATENT CORE-FORMING MACHINE.

A. Adjustable Shelf for carrying sand. B. Bar (steel reciprocating) shaped to suit straight, socket, taper or bell-mouth cores. C. Core on core-barrel. C 1. Collars same diameter as required core. C 2. Carriage with roller bearings, to carry core-barrel, adjusted vertically by means of rack and pinion. D. Driver (or sliding collar) for driving core-barrel. E. Eccentric. E 1. Eccentric rod. F. Fly wheel on main shaft. G. Gear (striking) for driving belt. H. Headstock. L. Legs to carry table casting. M. Main shaft. M 1. Main shaft brackets. Pulleys (fast and loose). R. Rollers to carry reciprocating bar. R 1. Brackets for ditto. S. Saddle, with adjustable screw motion, carrying roller bracket and sand shelf. T. Table or bed. W. Worm gear, steel worm and wheel, machine cut and hardened.

parts are capable of quick and easy adjustment, the sand board for carrying the sand being placed above the reciprocating bar and core barrel. The bar is shaped to form the socket at one operation, and two, three, or four different diameters can thus be formed on one and the same core.

The machine is belt driven, requiring ¼ to ½ h.p. only. The pulleys, 8 in. diameter, run 300 revolutions per minute, the reciprocating bar 300 strokes per minute. The core barrel revolves six revolutions per minute, being driven by worm gear.

The core barrel revolves on friction rollers, which are raised or lowered with rack and pinion to suit the varying diameters, the sand board and reciprocating bar are also adjusted with screw motions to suit any diameter of core, the adjustment from one core to another occupies about two to three minutes, parallel or taper cores being made with equal facility.

We are informed that cores of any length from 10 in. to 10 ft. can be made at the rate of twenty to forty per hour, and the cost for labour about ½d. to 1d. per core, suitable for pipes cast on flat, or inclined beds, or vertically in pits. Sand and water only are required for ordinary cores, no hay or wood wool rope being required, but for brass tubes, or for heavy cast tubes to be cast vertically, a special facing is used, to prevent the metal from cutting away the sand. The waste pipe from defective cores is necessarily much smaller than when made on the ordinary system, and the fue required for drying is also less. The standard size machine is for cores for pipes 9 ft. lay, the cores being about 10 ft. long, but machines can be made to produce cores 20 ft. in length

Improved Single and Double Automatic Motor Starting Rheostats.

THE Sturtevant Engineering Company, Ltd., of 147, Queen Victoria-street, have recently added a number of improvements to their single and double automatic motor starting rheostats.

To a very great extent the conditions which cover the design of a first-class starting rheostat have altered during the past two or three years, mainly because Corporations and Supply Companies have been raising the voltages of the supply and offering power to consumers at maximum voltages not previously in vogue. Those increased voltages have brought about more stringent rules for the protection of their network and their customers. The new conditions necessitate new types of motor starting and controlling apparatus, and it is to meet this demand that the "Igranic" starting switches have been produced.

The points necessary for the design of a reliable rheostat may be briefly stated as follows: There must be a sufficient number of contacts to ensure an easy acceleration of the motor. The starting rheostat must be provided with automatic releases to protect the motor in the event of failure of the supply, or of overloading. The resistances must be of ample carrying capacity, and must be so arranged that there is a minimum amount of sparking between the moving contact and fixed contacts. The method of assembling the resistance should be such that repairs in case of breakdown can be easily effected. The rheostat should be made of incombustible material throughout. No solder should be used in making the connections.

The resistance box should be so arranged that inspection of its interior can be made with little trouble. Ample ventilation should be allowed to prevent any portion of the starting switch overheating, and above all, the rheostat should be so designed as to give a high insulation resistance between any live part and earth.

The "Igranic" starting rheostat consists of a black enamelled slate front, having the contacts, between which the sections of resistance are connected, mounted upon it, and a cast-iron ventilated resistance box.

The contacts are of two sorts: (1) The button contact, which is used for currents not exceeding 55 amperes; and (2) the renewable contact, which is segmental in shape, used for currents exceeding 55 amperes.

The rheostat fronts are made in two patterns, one fitted with automatic no-volt release, which allows the contact arm to return to the off-position, in case of failure of supply; and the other fitted with automatic no-voltage release and overload cutout, the overload coming into effect when the current exceeds a predetermined amount. The front is provided

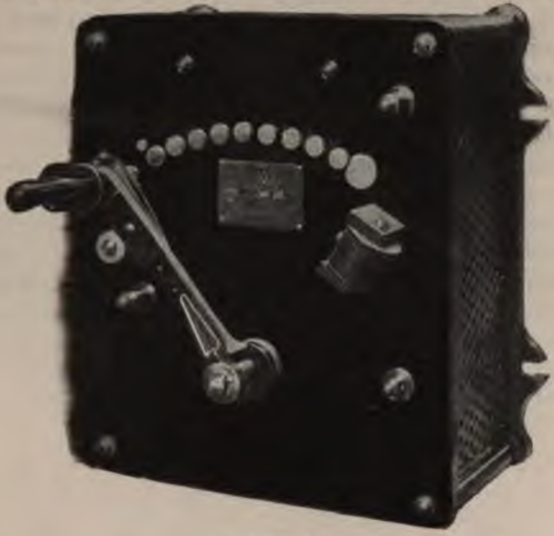


FIG. 1.

with suitable terminals for taking the main cables, and a terminal is also provided for taking the connection from the shunt, in the case of shunt-wound machines, to the no-voltage release coil.

The principal feature in connection with the "Igranic" starting rheostats is the arrangement of the resistance box. The slate front described above is screwed to a cast-iron box and insulated therefrom by means of insulating washers and bushes. The resistance material is wound upon asbestos tubes, the asbestos tubes being supported by specially-formed porcelain insulators. The insulators are held in specially-arranged perforated supporting strips, thus ensuring a very high insulation between the resistance material and the metal box. The connections between the contacts on the slate front and the sections of resistance are made by means of specially-formed clips, the connections all being made in chambers at either end of the resistance box.

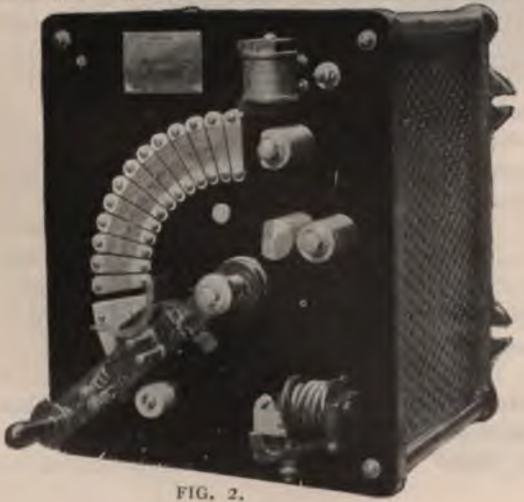


FIG. 2.

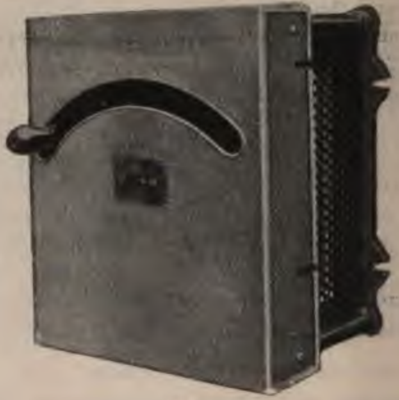


FIG. 3.

There are no internal connections in the resistance box, and every joint can be inspected at a moment's notice. The top, bottom, and sides of the cast-iron resistance box are covered by perforated sheet metal, held in position by spring clips at the corners. It is, therefore, possible to open up and inspect the resistance box without removing a single screw, and without requiring any special tools. All that has to be done is to remove the spring clips from the corners, take away the perforated sheet sides, and the whole of the interior is exposed to view.

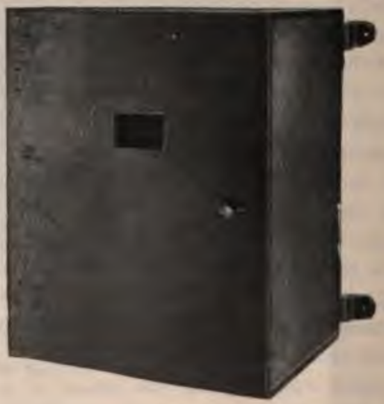


FIG. 4.

Figs. 1 and 2 show the open type; fig. 3 the semi-enclosed pattern, provided with a metal cover to protect the operator against contact with any live parts, and fig. 4 the totally-enclosed pattern, which is suitable for positions where dust, etc., would interfere with the working of the rheostat.

The new rheostats can be adapted for series, shunt or compound-wound motors.

LAUNCHES AND TRIAL TRIPS.

THE *Cambria*, a cable steamer, which has just been completed by Messrs. Swan, Hunter, and Wigham Richardson, Ltd., ran a very successful trial trip on Tuesday, January 31st. The steamer has been built to the order of the Telegraph Construction and Maintenance Company, Ltd., for whom the same builders recently constructed the *Colonia*, the largest cable steamer afloat. The *Cambria*, however, is a much smaller boat, and will be used not only for laying new cables, but also very extensively for repairing old ones. The steamer is classed at Lloyd's 100 A1. She has an overhanging bow and stern, on which are fitted the cable sheaves, and in her holds are tanks for carrying cable. Her engines have also been built by Swan, Hunter and Wigham Richardson, Ltd., and consist of two sets of triple expansion engines, which, on the trial trip, propelled the vessel at a speed of 13 knots. The Telegraph Construction and Maintenance Company were represented by Mr. F. R. Lucas, and there were also present Captain Cato, Mr. C. Slater, and Mr. G. Scott, N.A.

The new coastguard steamer *Squirrel*, built and engined by Messrs. Workman, Clark and Co., Ltd., has left Belfast for Sheerness, under the command of Lieut. E. H. Dobbin. The *Squirrel* is a smart-looking steel screw steamer, of yacht-like appearance, with an armament of two three-pounder quick-firing guns, and is in every respect fully equipped in accordance with the Admiralty requirements. Comfortable accommodation for officers and crew has been fitted complete with every requirement, while ample space is provided for the various stores, etc., required in the coast-guard service. The machinery consists of triple expansion engines with all necessary auxiliaries, including steam-steering gear and windlass, steam being supplied by a steel multitubular boiler, working at a pressure of 155 lb. per square inch. During the past week the vessel has undergone a complete series of trials, comprising power, speed, steering, gun firing, and anchor trials; also stability tests. The power trials included an eight-hour full power trial. All these tests were carried out most successfully, and to the complete satisfaction of the Admiralty officers. (See page 282.)

There was recently launched from the yard of Messrs. Palmer's Shipbuilding and Iron Company, Ltd., Jarrow, a steamship, *The Chama*, for Messrs. Elder, Dempster and Co., of Liverpool. The *Chama* is 350 ft. long, 48 ft. broad, and 23 ft. 4 in. deep. She has been designed to lift about 4,600 tons dead weight on her summer load draught.

The steel screw steamer *Bennie*, built to the order of Messrs. Elder, Dempster, and Co., for their West African trade from Liverpool, has been launched from the East Shipbuilding Yard, of Messrs. Swan, Hunter and Wigham Richardson, Ltd., Wallsend-on-Tyne. The vessel is of the following leading dimensions: Length over all, 362 ft.; beam, extreme, 48 ft. 3 in., and depth moulded, 32 ft. to shelter deck. The vessel is expected to carry a dead-weight cargo of about 4,600 tons on a draught of 21 ft. The machinery has been constructed by the Wallsend Slipway and Engineering Company

The large steel screw steamer *Harmonic* proceeded on her official trial trip, after adjusting compasses in Hartlepool Bay. The vessel has been built by Messrs. Furness, Withy and Co., Ltd., Hartlepool, to the order of Messrs. J. and C. Harrison, Ltd., and is the second of three sister ships for the same owners. She is over 335 ft. in length, built on the deep-frame principle, with a measurement capacity of 264,126 cubic feet. The main engines have been supplied and fitted by Messrs. Richardsons, Westgarth and Co., Ltd., Hartlepool.

Messrs. Archd. McMillan and Son, Ltd., shipbuilders, Dumbarton, launched recently the steel screw steamer *Saint Jerome*, the second of two which they have built for the order of Messrs. Rankin, Gilmour and Co., of Liverpool. The moulded dimensions are: Length, 345 ft.; breadth, 47 ft. 6 in.; depth, 24 ft. 9 in.; and the vessel is designed to carry a dead weight of 5,500 tons on a light draft. Machinery is being supplied by Messrs. Dunsmuir and Jackson, Ltd., Glasgow, for a sea speed of 10 knots.

On Monday afternoon the 6th inst., Messrs. Ropner and Son, Stockton-on-Tees, launched from their yard a steel screw steamer, *Blacktor*, of the following dimensions: Length, 330 ft. 1 in.; breadth, 46 ft.; depth, 24 ft. 4 in The vessel will be classed 100 A1. at Lloyd's, and is built on the three-deck rule, having one deck laid and clear holds, full poop, long bridge, and T. C. forecastle. The vessel has a double bottom for water ballast on the cellular principle, and also in the after peak. The appliances for loading and discharging the cargo expeditiously are very complete and include six steam winches, steam being supplied by a horizontal multitubular donkey boiler.

MECHANICS OF FLOUR MILLING.

A paper on this subject was read before the Civil and Mechanical Engineers' Society on February 2nd, by Mr. A. R. Tatterrsall. The following is an abstract:—

Much of the controversy amongst milling engineers has waged around the design of the roller mill itself. The essential features of a successful roller mill have eventually been proved to be—first, a roll, having elastic levers, which would keep the adjustable roller at its work and at the same time allow any hard or metallic substance which might get between the rolls, to pass through without breaking the lever; secondly, bearings having oil-circulating arrangements; thirdly, chevron gears to maintain an exact differential speed between the two rollers working together; fourthly, a reliable adjustment to ensure an even pressure along the whole surface of the roll; fifthly, an even distributed feed across the roll, which must be spread out in as thin a stream as is possible; and, lastly, the whole set up in a substantial framework, so as to obviate any tendency to vibration and offering easy access to all parts requiring adjustment; the whole so placed that the machine can be properly ventilated with the dual object of keeping the stock cool and preventing the escape of dust. The actual grinding surfaces are made of chilled iron cast in an iron mould. As these rolls are used in flour manufacture for two purposes, "breaks" and "reductions," to make a difference in the metal used for each purpose is the best practice, and for this reason, that the "break" rolls, after having been ground true on the emery wheel are fluted or grooved by a special tool with a slight lead or spiral twist of about 1 in. per 1 ft. in the length of the roller to break open the wheat as it passes, whereas the "reductions" or grindings of the semolina are made on entirely smooth surfaces so that the metal composing the casting may be denser and harder. The cast roller is hollow in the middle, but each end is cored so as to require boring to receive the spindle, which is turned slightly thicker than the hole left, so that the spindle is forced into its place by means of hydraulic power, and is not keyed on. Experience has shown this to be the only satisfactory method of securing the spindle. Another feature to be pointed out is that the two rollers running in contact are revolving at differential speeds, 250 to 100 for "break" or grooved rolls, and 250 to 200 in the case of smooth rolls. This differential speed is maintained by means of chevron gears, working in oil-tight cases, so that, when in operation, they are comparatively noiseless. The rolls are now generally placed on the diagonal method, that being considered better than to give them horizontal setting (fig. 2).

Another debatable matter in connection with these rollers is as to which roller of the two should be the fast and which the slow roller. It is obviously mechanically correct to make the fast roll the one running in fixed bearings, and the adjustable roll the slow running one, but in the case of rolls shown by the author this slower roll is placed below the other, so that the pressure is exerted upwards against the top one to do the grinding

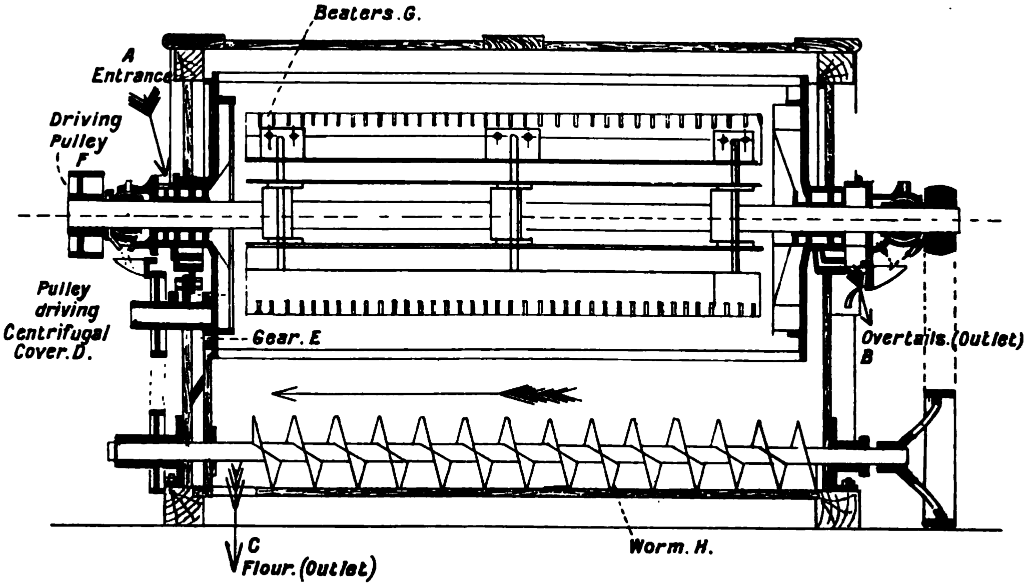


FIG. 1. CENTRIFUGAL FLOUR-DRESSING MACHINE WITH WORM FEED AND OUTLET.

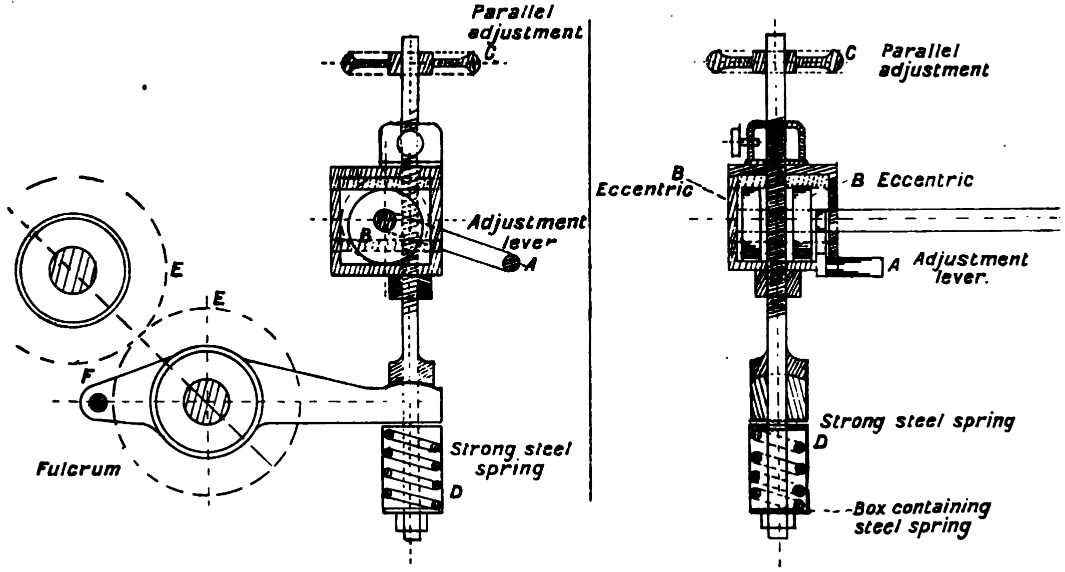


FIG. 2.—ADJUSTMENT OF DIAGONAL ROLLS.

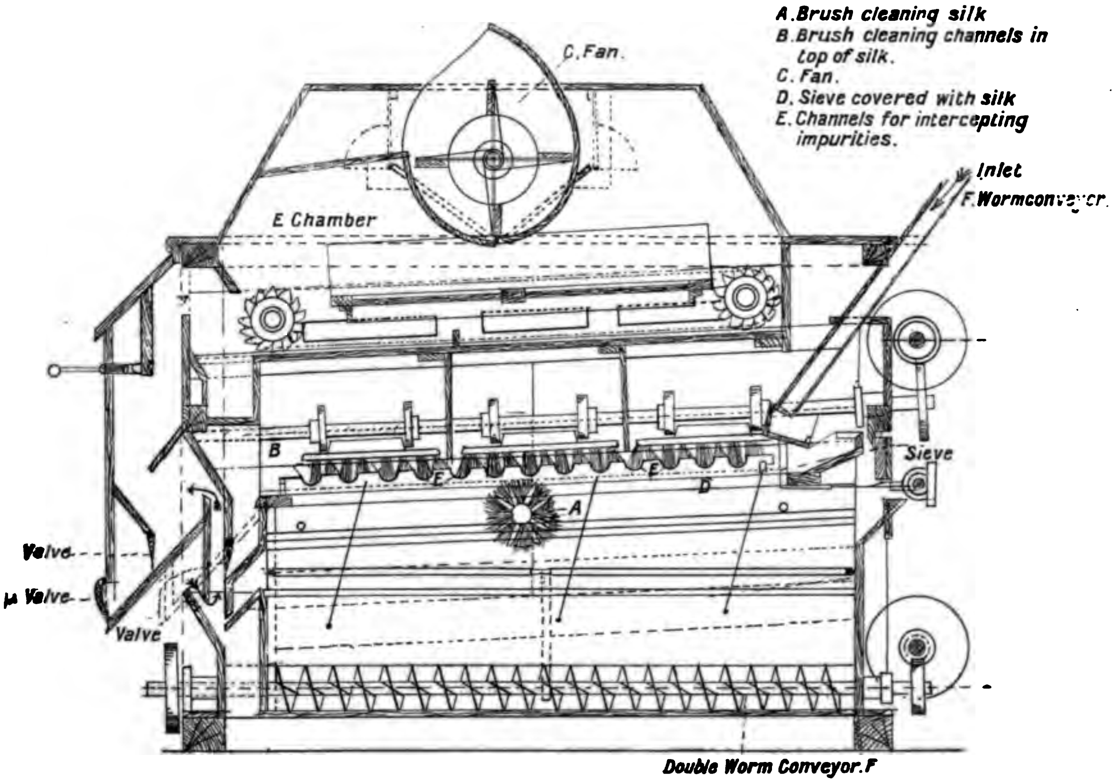


FIG. 3.—DUSTLESS PURIFIER.

The second machine of importance is the purifier (fig. 3) which has to deal with all the semolina and middlings made in the process of breaking down the wheat on the fluted rolls. After the little flour has been dusted away this semolina is graded into several sizes, and passes on to the several purifiers, clothed with suitable numbers of woven silk according to the size of the stock it has to deal with.

This purifier consists of a vibrating sifter D, having a slight inclination from head to tail, and enclosed in an air-tight frame. A fan C is superposed which sucks or draws air up through the silk covered sieve, taking with it all particles of less specific gravity than the pure stock; the latter drops down through the silk into a collecting worm F. The space down the sieve is divided across by wooden partitions, to each of which an air current is supplied of varying strength, light at the head end where the silk cover is finest, and heavier at the tail end where the silk cover is coarser.

The air as it passes away from the silk to the fans, laden with the light impurities, passes through a series of channels E E, placed quite close to the silk, and after passing through these channels expands, and the heavier particles drop into these channels while the lighter ones pass upwards into a large expansion chamber E C, and are caught while the pure air blows out at the mouth of the fan into the room.

SOCIETY OF ENGINEERS.

Mr. Nicholas J. West, the new President of the Society of Engineers, delivered his presidential address on Monday evening last. He chose for his subject a branch of the mechanical side of engineering more particularly with reference to the historical use and improvement of pumping and marine engines

At the same meeting the retiring President, Mr. D. B. Butler, presented the premiums awarded for papers read during the year. The President's gold medal was awarded to Mr. William Edward Storey for his paper on Condensing Machinery; the Bessemer Premium of Books to Mr. R. G. Allanson-Winn for his paper on Deep Sea Erosion and Foreshore Protection; a Society's Premium of Books to Mr. A. S. E. Ackermann for his paper on British and American Coal-cutting Machines; and a Society s Premium of Books to Mr. Frank Latham for his paper on Some Recent Works of Water Supply at Penzance.

OVERHEAD MAINS.

At the meeting of the Institution of Electrical Engineers, held at Great George Street, S.W., yesterday, a paper by Mr. G. L. Addenbrooke was on the agenda: "The Value of Overhead Mains for Electric Distribution in the United Kingdom," of which the following is an abstract :—

On the Continent and in America, outside considerable towns, electric transmission has almost universally been carried out by means of overhead mains. Unfortunately, until recently in this country, officialism and to some extent public sentiment have prevented the employment of this method on any scale.

Wiser counsels now prevail, and it is now possible to consider systems of transmission of this character in the United Kingdom, and it becomes of practical importance to see how they compare with underground transmission, and what difference their employment may make in the policy and procedure of power companies.

The tables on page 317 show the cost of overhead conductors and underground mains employed under similar conditions. The figures must be regarded as approximate, as so much depends in any given case on the amount of work to be done, the locality and other conditions, but still they are near enough for the present purpose. The costs in both cases are for high-class work, and this applies particularly to overhead work.

An inspection of these tables will show that at 6,000 volts between conductors on a three-phase system the cost of the overhead conductors is about half that for underground cables. If the voltage is increased, the cost of the overhead line only rises slightly, while the cost of the cables increases more rapidly, so that at 10,000 volts the cost of underground is nearly three times the cost of overhead transmission. In the cost for the overhead transmission a fair sum is included for extra poles and networks when crossing roads or places to which the public have access.

In these tables the costs of overhead conductors have been calculated on the basis of a single set of conductors of the sizes mentioned on a pole, but when more power is wanted a second set of conductors can usually be added at the cost for copper, insulators, arms and erection only, whereas to lay a second cable will cost practically as large a sum as the first. Herein lies one of the great advantages of overhead distribution. Thus, by employing overhead conductors a power company is sinking a much smaller amount of capital in extending its mains widely during its early stages.

OVERHEAD MAINS.—THREE-PHASE CABLES.

ON THE BASIS OF ONE PER CENT. LOSS PER MILE.

Particulars of the Conductors.			Carrying Capacity in Kilowatts at the following Voltages.				Capital Cost of Line complete per Mile, allowing 45 Poles per Mile at the following Voltages.				Capital Cost of Line complete per Kilowatt conveyed per Mile at the following Voltages.			
Size of Cables.	Section of Cables in Square Inches.	Weight per Mile in lbs.	6,000.	8,000.	10,000.	12,000.	6,000.	8,000.	10,000.	12.000.	6,000.	8,000.	10,000.	12,000.
3—7/18	3 ·01292	3 × 266	81	152	225	323	£211	£230	£245	£260	52/-	30/-	22/-	16/-
3—7/16	3 ·02299	3 × 468	143	254	400	545	£259	£275	£290	£305	36/3	21/8	14/6	11/3
3—7/14	3 ·03588	3 × 730	222	394	615	887	£301	£316	£332	£347	27/-	16/-	10/9	7/10
3—19/16	3 ·06247	3 × 1270	382	680	1,060	1.526	£402	£418	£433	£448	21/-	12/4	8/2	5/10

UNDERGROUND MAINS.—THREE-PHASE CABLES.

ON THE BASIS OF ONE PER CENT. LOSS PER MILE.

Particulars of the Conductors.			Carrying Capacity in Kilowatts at the following Voltages.				Cost of Main complete laid and jointed at the following Voltages.				Cost of Line complete per Kilowatt conveyed per Mile at the following Voltages.			
Size of Cables.	Section of Cables in Square Inches.	Weight per Mile in lbs.	6,000.	8,000.	10,000.	12,000.	6,000.	8,000.	10,000.	12,000.	6,000.	8.000.	10,000.	12.000.
3—7/18	3 ·01292	3 × 266	81	152	225	323	£490	£540	£678	£800	120/-	71/-	60/-	49/6
3—7/16	3 ·02299	3 × 468	143	254	400	545	£520	£635	£725	£870	73/-	50/-	36/-	32/-
3—7/14	3 ·03588	3 × 730	222	394	615	887	£545	£660	£772	£950	49/-	34/-	25/-	21/-
3—19/16	3 ·06247	3 × 1270	382	680	1,060	1,526	£760	£858	£957	£1,050	40/-	25/-	18/-	13/9

Besides the lower cost per mile of the distributing system with overhead mains, and which in many cases would make the difference whether a supply can be given profitably or not, it is important to observe also that if it will pay to carry the current a certain distance by underground mains, it will pay to carry the current nearly twice as far with overhead conductors; which means that a power station can economically supply current over about three times the area which would be possible with underground transmission at 6,000 volts, and if the pressure is increased the relative areas show a still greater difference.

It is also important to bear in mind that overhead conductors are, comparatively speaking, free from the complicated phenomena known as resonance effects, which give a good deal of trouble on underground circuits and have been the cause of much anxiety.

There is no reason why, with overhead distribution and a cheap system of wiring, such as is in use everywhere except in this country, all these smaller centres of population and the outskirts of the larger towns should not enjoy the benefits of electric light and power supply, which they are hardly likely to do for another twenty years without this system of distribution.

It is, further, worth pointing out that most of the local distribution abroad is at 110 volts. With 240 volts, such as we use largely here, the problems involved are much simpler.

It ought to be the function of power companies to feed these towns and villages by lines of overhead mains radiating twelve to fifteen miles in all directions round each power station, and the undertakings being in groups, economic and effective administration would be secured, and the disadvantages and lack of efficiency of separate small undertakings would be avoided.

That there is a large field open for future work in this direction, no one who has studied the question will deny, and it is very much allied to the question of inter-urban electric railways, in which so much progress has already been made in the United States.

In conclusion, the author refers to another class of overhead electric distribution which is fast attaining an important place, namely, distribution at very high pressures such as 50,000 volts. The continued success and extension of such installations warrants them being considered not only as local enterprises specially arranged to meet some unusual set of conditions, but as being of general application. When electric distribution is effected at these voltages, not only do we get into a new order of phenomena electrically, but economically also. The capital cost of the line comes down to from 1s. 6d. to 2s. per kilowatt conveyed per mile, with a loss of, say, one-fifth of 1 per cent. per mile. The overhead electric transmission of power and light will be one of the most potent factors in developing new industrial and mining regions in the next twenty or thirty years.

HYDRAULIC PRESSING, STAMPING AND FORGING MACHINERY.

(*Continued from page 264.*)

HYDRAULIC FORGING PRESSES.

Valves are generally the most vital portion of a press, a badly designed valve being a source of endless trouble and expense. In a slow working press for low pressures the valve is usually made of the screw down type, or of the leather packed piston type, or slide valve type. Beyond 1 ton per square inch, valves are made of the balanced mitre type with forged-steel bodies and heavy phosphor bronze fittings. In a large press of quick action and heavy pressure, where the valves and pipes are of large area, it is necessary for the valves to be hydraulically or fluid worked.

Circumstances determine whether the motive power shall be hand, electric or steam.

In presses, of large power, say of 500 tons and upwards, it is essential that every part should be extra strong and rigid, and all parts with a low stress. The load may not always be central on the work, for which contingency the columns are usually proportioned on each side to take three-quarters the load with very deep guides on the crosshead for side strains. In presses of large calibre the entablature and base are often built up of cast steel girders joggled and bolted together, or with steel hoop shrunk on over snugs to take any side stresses. The presses are operated in different manners, one method being to have a steam accumulator for operating the lifting cylinders, and a set of three-throw hydraulic pumping engines for pumping direct at a pressure of three tons per square inch into the press cylinder, the main ram falling by gravity and filled with water from an overhead tank. With the pumping engine system, the steam consumption is more economical than with direct steam drivers. In a large forge works this is of not such great importance, as the waste gases from the heating furnaces are utilised for generating steam. Probably for which reason the steam hydraulic press is largely used, this type also having the advantage in first cost. A description of its working may be interesting.

The squeeze is applied by means of a steam-driven intensifier. The hydraulic cylinder of the intensifier is connected by a pipe to the cylinder of the press and the pipe and the two cylinders are kept filled with water from an overload tank through a valve, which opens downwards to admit water from without, and closes against any pressure from within the cylinders.

METHOD OF WORKING.

The area of the steam piston and that of the ram of the intensifier are so proportioned to each other that a pressure of steam produces a pressure 3 tons per square inch on the water above the forcing ram. To squeeze the forging, the workman depresses a hand lever, which moves a valve admitting steam below the piston of the intensifier, causing the forcing ram to drive the water into the cylinder of the press; the ram and crosshead is thus moved downwards. By raising the lever steam escapes from below the piston of the intensifier, when the piston and ram fall by gravity. The lifting of the moving head of the press is actuated by two cylinders on top of press; in this press steam instead of water is used to do the lifting, the admission of steam to the lifting cylinders being controlled at will by a small three way cock, which enables the press to be worked in two distinct ways.

In the usual method of working, the pressure of steam is maintained continuously below the pistons of the lifting cylinders, thus holding the head up until steam is admitted below the piston of the intensifier, which overcomes the pressure of the steam in the lifting cylinders and drives it back into the boiler. On again releasing the steam from below the piston of the intensifier the lifting pistons regain their power and force the water back into the top of the intensifier, but as the quantity contained in the pressing cylinder and intensifier with their connecting pipe remains constant, the moving head of the press rises and falls through a distance due to the influence of the pressing and lifting cylinders. These prevail alternately one over the other, the rise and fall between the two fixed points being in accord with the movement of the workman's hand, thus squeezing the forging and permitting it to be moved along after each stroke ready for a fresh squeeze to be taken on a new part. If the normal stroke of the crosshead is insufficient it can be made to travel through a second and lower interval by merely turning the three way cock. This shuts off the constant supply of steam below the pistons of the lifting cylinders, with the result that the head remains stationary and water flows in from the overhead tank, and fills the vacant space left by the forcing ram of the intensifier. Then, as soon as steam is admitted below the piston of the intensifier, the press head descends through a second interval. This action may be repeated until the whole available stroke of the presshead is used up, or until the material under treatment offers such resistance that it must be moved into a new position for another part to be squeezed.

FUEL ECONOMY IN STEAM POWER PLANT.

There was an interesting discussion on Messrs. Booth and Kershaw's paper on this subject at the last meeting of the Institution of Electrical Engineers.

Mr. John C. B. Kershaw opened the proceedings with a few experiments in illustrations of the paper. His first experiments were designed to show the different character of the gases given off when using anthracite, South Wales steam, and ordinary Lancashire coal. The anthracite contained 3·7 per cent. of volatile matter, the South Wales steam coal 12 per cent., and the bituminous specimen 32 per cent. He next illustrated by the aid of a candle and a piece of copper wire the manner in which a cold surface brought into contact with a flame robs it of its heat, and then showed through the agency of a wire gauge and a Bunsen flame the effect of a cold conducting surface. It remained to be considered, he pointed out, whether scale was a worse conductor than boiler-plate iron, and another experiment was designed to show the relative heat conductivity of boiler-plate scale and oil scale. He wished to emphasise the importance of testing the flue gases.

Col. Crompton said that the matters discussed in the paper were of the first importance to electrical engineers, particularly those connected with power and lighting plant. With regard to the question of temperatures of flames and the cooling surfaces of boiler plates, he agreed with the authors. There was no doubt that a great deal of the discredit brought upon water-tube boilers in their early days was due to mistakes in the brickwork setting. The ideas of some people with regard to smoke consumption were limited to passing excess of air through the furnace and thus producing a cooling effect. The problem was to prevent smoke without loss, and in this respect the author's remedy was the correct one. It was a question of suitable furnace construction. Then there was what he might fairly term the great puzzle of thermal storage, which he thought was going to be one of the great advantages which electrical engineers could introduce into stations where they had to deal with a peak load. Thermal storage produced economies which were quite inexplicable with the light of present knowledge. It was not a question of getting 25 or 30 per cent. extra, but 200 per cent. extra gain in boiler power at the peak. The problem was being investigated and he hoped that in a year or two the electrical industry would be in possession of some useful facts in this connection. Thermal storage had reduced coal consumption in a station which was previously a model for economical working in other respects, by the difference between 4 and 2·9.

He differed from Mr. Booth in his hankering after Lancashire boilers. With the water-tube boilers the furnaces could be designed in a manner impossible with the Lancashire. The furnace problem was a fuel problem. He did not think that the results to be obtained with the inclosed grate were at all comparable with those to be got from a flat grate working on the chain principle, or on the principle which propelled fuel from the front to the back and only passed it through when combustion had been completed.

To the question of superheated steam he had paid a good deal of attention, and the views he held were those of people with whom he was not ashamed to be in company. With superheated steam, advantages were obtained the whole way up the scale, so that 1,000° F. was better than 500 deg. The use of very highly heated steam had produced results which could not be accounted for by the ordinary third law, and the only explanation was that former knowledge was incomplete. Quite apart from the thermo-dynamic advantage, it had been pointed out by Messrs. Callender and Nicholson that superheated steam had enormous advantages in preventing leakage over sliding surfaces. With regard to the charge made against superheated steam of scoring and cutting the cylinder it only needed that it should be lubricated to a certain extent. With steam at 300 deg. to 400 deg. above the saturation point consumption could be reduced from 30 to 40 per cent. On this subject a new practice could be built up with steam engineering. In this way the steam engine could be made to keep pace with the internal-combustion engine. The time would come when steam would be taken at 1,000 deg. and discharged at 200 deg.

Mr. Boot said that he found no difficulty in separating the grease with a separator, the only objection being the loss of 5 per cent. of water in addition to the ordinary losses. He had tried the heating of feed water to the same temperature as the water in the boilers, and the deposits were thrown down in trays arranged for the purpose. It was impossible to carry out all the tests suggested in the paper by reason of the number of men required. Station engineers looked at the lbs. of coal per unit, and if they found the consumption going up they then looked into the matter. They were compelled to regard the coal per unit test as a sufficient one. He was surprised to hear Col. Crompton speak against Lancashire boilers which certainly had their uses in an electrical plant where there were variations of loads and where steam had to be stored ready for use at a moment's notice.

With regard to refractory furnaces it had often been a surprise to him why some makers of water-tube boilers continued to sell boilers designed on barbarous principles as far as fuel combustion was concerned. The question of the kind of fuel to be used was to a large extent a question of location and carriage, and where rates were high it was cheaper to use the best coal. He, personally, had never got above 18 per cent. saving by the use of superheated steam.

Mr. Halpin did not believe in paying fancy prices for coal, as the extra work was not worth the extra price. Inferior coal could be used without smoke and to the best possible results.

Mr. Dale said that at Messrs. Crossfield's Works, Warrington, owing to the varying hardness of the water they analysed it every day. They had obtained great advantage in the matter of superheating by utilising the top of the Lancashire boiler, usually covered with non-conducting material, as a heating surface and sending the gases through tubes into the superheating chamber. In that way they gained about 70 deg. to 80 deg. of superheat. The arrangement had been in use for several years and worked satisfactorily.

The discussion was adjourned.

An 8-ft. steel chimney, 230 ft. in height, has just been completed and will be erected in Mexico. This will be the highest steel chimney in America.

The orders given in January for new vessels to be built on the Clyde are stated to equal 169,000 gross tons, and to be a record in tonnage. The north-east coast shipbuilders during the same period received proportionately large orders. Belfast claims to have secured 210,000 tons of new work.

Mr. James C. Inglis, general manager of the Great Western Railway, has been nominated by the Council of the Institution of Civil Engineers as one of their representatives on the Engineering Standards Committee, in the place of the late Mr. John Allen McDonald, engineer-in-chief of the Midland Railway.

It is a significant fact that to the 1905 edition of Garcke's Manual of Electrical Undertakings and Directory two hundred more pages have been added, bringing the total up to about 1,700 pages, which is over four times the size of the first volume, published in 1896. The number of undertakings about which particulars were given in the first volume was two hundred, now that figure has grown to close on 2,400, while the amount of capital issued in connection with these undertakings, which include, of course, both municipal and joint-stock enterprises, has risen from a little over £61,000,000 to close on £267,000,000.

AN ELECTRIC WINDER FOR THE RAND.

The first large electric hoist adopted for deep-level developments on the Rand has been ordered for the Village Main Reef Gold Mine. The winder will be placed at a vertical depth of 1,100 ft. and will haul on a 1,700 ft. incline. The generating plant will be of 900, and the hoist of 500 h.p. Messrs. W. H. Allen, Son and Co., represented locally by the Technical and Commercial Corporation, Ltd., will be the manufacturers of the steaming plant, and Fraser and Chalmers, Ltd., of the mechanical parts of the hoist, whilst the electric installation will be provided by the A. E. G. Electrical Company of South Africa. The three-phase system as adopted by that Company with a liquid starting resistance will be used, and it is expected that the plant will be at work in about seven months.

OBITUARY.

Mr. Frederick Gordon, whose death is reported from Sunderland, had extensive business interests on the East Coast. He was managing director of Johnasson Gordon and Co., Ltd., of Newcastle, the East Coast Engineering and Shipbuilding Company, Tyne Dock, and of the Gordon Steam Shipping Company, Ltd., London and Newcastle. He was also a member of the River Wear Commission, and his experience admirably fitted him for the chairmanship of the Traffic Committee of that body.

Mr. James E. Ransome, to whose death reference is made elsewhere, was a man of many parts. To the engineering public he was chiefly known as the head of the famous Ipswich firm, founded by his grandfather in 1789. Mr. James Ransome has been the head of this undertaking for many years, and he worthily sustained the high traditions of a great business. It was natural, of course, that his name should have been associated with the Royal Agricultural Society, and he was also on the Council of the Bath and West of England Society, and the Agricultural Engineers' Association. Nor did his activities end here, for he played an important part in Ipswich local affairs, and was intimately associated with the extension educational facilities in that town. His death at the comparatively early age of sixty-six is a matter for genuine regret.

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts.

CONTRACTS OPEN.

Last Day.

Ghent.—Supply of fifteen electric cranes for use in connection with the docks. Hotel de Ville, Ghent .. .. Feb. 13

Bury.—Supply and erection of one 500 k.w. direct-current high-speed generating set. Mr. S. J. Watson, Electricity Works, Bury Feb. 14

Lagos.—The Crown Agents for the Colonies invite tenders for the supply of steel rails, fish-plates, and steel sleepers for thirty miles of single track. Crown Agents Office, Whitehall Gardens, S.W. ... ... Feb. 14

Manchester.—Supply and erection of a main switchboard, auxiliary distribution board, etc, for car repairing works. Mr. J. M. McElroy, General Manager, Tramways Department, 55, Piccadilly, Manchester ... ... Feb. 14

Merthyr Tydvil. — Supply of between 5,700 and 6,000 tons of cast-iron pipes for high-level aqueduct, valves, etc. Mr. George F. Deacon, 16, Great George Street, Westminster, S.W., or Clerk, Town Hall, Merthyr Tydvil ... ... Feb. 15

Bournemouth.—Three contracts in connection with tramways. (a) Steel grooved girder rails; (b) permanent-way construction and rail bonding; (c) wood blocks and granite at edging. Mr. F. W. Lacey, Borough Engineer, Bournemouth ... Feb. 15

Newcastle-under-Lyme—Manufacture delivery and erection of three sets of gas engines and centrifugal pumps for sewage disposal works. Messrs. Wilcox and Raikes, 63, Temple Street, Birmingham... Feb. 22

Fulham. — Supply of condensing plant, boilers, economisers and stokers. Mr. Arthur J. Fuller, Borough Electrical and Consulting Engineer, Town Hall, Fulham Feb. 22

Chelmsford.—Pumping machinery including horizontal gas-engine and a vertical treble ram-pump to raise 10,000 gallons of water per hour. Mr. Jos. Dewhurst, Engineer, Avenue Chambers, Chelmsford. Feb. 24

Copenhagen.—Supply and erection of a gasometer of a capacity of 200,000 cubic feet per hour for the Lighting Department of the Corporation. Valby Gasworks, Valby, Copenhagen ... ... Feb. 27

Barcelona.—The "Gaceta de Madrid" of January 18th contains a notice calling for tenders for the supply and installation in the sheds of the Barceloneta wharf of two transhipment cars for platform cranes. Conditions of contract and plans may be inspected at the offices of the Secretary of the Port Administration, Casa Lonja, Barcelona ... ... March 1

Johannesburg.—Supply of 100 electric cars, two electric water-cars, five-ton crane, car traverser, and workshop tools for Municipal Council .. .. March 6

Last Day.

Stoke Newington.—Supply, delivery and erection of sub-station plant and mains. Four-section contract. Mr. W. F. Loveday, Borough Surveyor, Town Hall, Milton Road, Stoke Newington, S.E. ... ... March 8

Belgium.—The "Bulletin Commercial" announces that the Belgian State Railways invite tenders for the installation of two sets of ventilating and heating apparatus in the central workshops at Mechlin. Particulars of M. Slaghmuylder, Engineer-in-chief, Station du Nord, Brussels .. March 6
March 13

South Shields.—Supply, delivery and erection of the following plant in connection with the electricity supply department :—One multitubular marine type boiler, two medium-speed open-type vertical engines for two 550 k w. direct current traction generators, two 500 k.w. direct current generators and traction switchboard. Mr. J. H. Cawthra, Borough Electrical Engineer March 13

Madagascar.—Plant and machinery are required for the establishment of a pumping station at Majunga, Madagascar. Particulars may be obtained from the Minister of the Colonies, 4, Rue Jean Nicot, Paris ... ... —

Chile.—News has been received at the Commercial Intelligence Branch of the Board of Trade from the British Vice-Consul, at Santiago (Mr. A. C. Kerr), notifying that tenders for the Valparaiso harbour works will be opened in April, 1906. Specifications will be sent to the various Chilian Legations in Europe and the United States ... ... Apr. 1906

COMING CONTRACTS.

Hammersmith.—The London County Council has sanctioned the borrowing by the Borough Council of £18,482 for electric supply purposes.

Hull.—A sum of £36,000 will be spent during the ensuing financial year on electrical engineering works.

Macclesfield.—A proposal is being put forward to borrow a sum of £20,000 for electric supply purposes.

Wakefield.—The Corporation has under consideration a scheme which involves the spending of £18,000 on electric supply plant.

Sunderland.—Application is being made for a loan of £15,000 for additional electric supply plant.

Western Valleys (Mon.)—It is intended shortly to advertise for tenders for sewage works at an estimated cost of about £257,000.

London.—The City and South London Railway is about to invite tenders for the construction of express cars.

CONTRACTS CLOSED.

Cheltenham.—The Corporation has accepted the tender of the Lancashire Dynamo and Motor Company, Trafford Park, for automatic reversible booster, Turnbull and McLeod pattern, with switchboard.

London.—The Thames Electrical Engineering Works have placed orders with Reavell and Co., Ltd., for engines for twenty lighting sets for London County Council steamers.

Canterbury.—Davey, Paxman and Co. have secured an order for a generating set from the Swindon Corporation, and a contract for boiler and superheater from the Canterbury Town Council.

Dover.—The Dover Town Council has accepted the tender of the British Electric Equipment Company, Ltd., for the construction of the permanent way, overhead equipment, and laying the feeder cables in connection with the Dover and River Light Railways.

London.—The London General Omnibus Company have ordered six motor-buses from the Wolseley Company, to be ready by the end of March. The Great Western Railway Company and the Birmingham Motor Express Company have also ordered motor-buses from the Wolseley firm.

South Africa.—Ernest Newell and Co. Ltd., have secured a large order for tube mills for grinding concentrates down to slime for a large gold mining company in South Africa.

G. I. P. Railway.—The Great Indian Peninsula Railway have given a contract to Kerr, Stuart and Co. Ltd., for motor coaches as designed by that firm.

London.—The Hart Accumulator Company have given an order to Measures Bros. Ltd., for cast-iron columns and rolled steel joists.

Birkenhead.—The Tranmere Bay Development Company, Ltd., Birkenhead, has ordered from the Power-Gas Corporation, Ltd., a power-gas plant of 6,000-h.p. capacity. The larger portion of the gas generated is intended for firing furnaces; the remainder will drive two 400 indicated h.p., and three 250 indicated h.p., Premier gas engines, each direct-coupled to a Bruce Peebles dynamo.

Shipley.—Graham, Morton and Co. Ltd., Leeds, have just obtained an order from Messrs. Jonathan Barker and Co., Esholt, Shipley, for the installation of an overhead tram-rail. By the introduction of this plant it has been estimated that a saving will be effected sufficient to pay for its installation within a year.

Sunderland.—The River Wear Commissioners have placed an important contract for structural work in connection with the erection of additional coal staithes at the South Dock, Sunderland, with John Abbot and Co., of Gateshead.

Glasgow.—Brownlie and Murray, Ltd., have just received contracts for shipment abroad, among these being a furnace for the City of Calcutta, steel structural work for 480 ft. span suspension bridge, buildings for two large engineering shops.

Bishop Auckland.—Graham Morton and Company, Ltd., have secured a contract to make additions to the extensive coal screening plant for the Dean and Chapter New Colliery, at Bishop Auckland, County Durham, belonging to Messrs. Bolckow, Vaughan and Company, which will enable it to handle 5,000 tons per day.

London.—Among orders recently executed and received by the Paterson Engineering Company, Ltd., for "Paterson Feed Water Purifiers" are the following: Messrs. Babcock and Wilcox, Ltd., for H.M. Dockyards, Pembroke; Gosport and Fareham Tramways; Messrs. Belliss and Morcom, Ltd., for their Ledsam Street Works; Messrs. Danks and Company for H.M. Dockyards, Chatham; Messrs. The Electric Construction Company (2) for H.M. Dockyards, Gibraltar; Messrs. The Mirrlees Watson Company for Partick Electricity Works; Messrs. Crompton and Company for Ultadunga Station, Calcutta; Messrs. The Earl of Rosslyn's Collieries Company, Ltd.

APPOINTMENTS VACANT.

Last Day.

Birmingham.—Chemist to take charge of a new 20-ton per diem coal-testing plant, fitted with regenerative retort settings. Chairman of Works, Sub-Committee of Gas Department, Council House, Birmingham ... ... Feb. 20

City Corporation.—Mr. D. J. Ross, engineer and surveyor to the City Corporation, is retiring on account of ill-health. At a joint meeting of the Officers and Clerks, the Finance and the Improvements committees, it was decided to advertise for a successor. The salary was fixed at £1,500, rising to £2,000. Candidates must not be over fifty years of age .. ... —

London County Council.—Engineering assistant, at a salary of £500 per annum. Must be a member or associate member of the Institution of Civil Engineers, and have had experience. Particulars of Clerk to the Council, Spring Gardens, S.W. ... ... Feb. 20

Newcastle.—Electrical Engineers to take charge of shift at Carville Power Station. Mr. J. S. Watson, Newcastle-upon-Tyne Electric Supply Company ... ... —

APPOINTMENTS FILLED.

Hanley.—The Hanley Corporation has appointed Mr. C. H. Yeaman, chief assistant in the Islington Borough Council electricity works, as borough electrical engineer of Hanley.

Wakefield.—The Wakefield Electricity Committee has recommended that Mr. H. A. Neville, chief assistant engineer at the electric supply works, shall be chief electrical engineer. The commencing salary is £300 per annum.

Manchester.—Mr. C. H. K. Chamen, who has been employed at the Glasgow Corporation electricity works as mains laying superintendent, has received the appointment of superintendent of mains to the Lancashire Electric Power Company.

Belfast.—Mr. Arthur King, Sheffield, has been appointed overhead construction superintendent to the Belfast tramways. Mr. King was formerly with the British Electric Equipment Company and in the Sheffield Corporation's tramways department.

Hammersmith.—Mr. Wm. R. Nice, of the Lancaster Corporation electricity works, has been appointed superintendent of the meter and testing department at the Hammersmith Corporation electricity works.

India.—Mr. Meares, electrical engineer, Bengal, has been appointed electrical adviser to the Government of India.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares business is urrently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our ist will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from inaccuracies.

Stock Exchange Settling Days.—Settling days on the Stock Exchange are as follows:—

ols: March 1st. General Settlements: February 10th, 24th, March 15th. Bank Rate, April 21st, 1904, 3 per cent.

-ENGINEERING, IRON, AND STEEL COMPANIES.

Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
5	5%	Alldays & Onions Pneumatic Engineering, Ltd.	3	2½— 3
5	3/-	Do. Cum. Pref. 6 per cent. ..	5	4½— 5
1	2/6	Armstrong (Sir W. G.), Whitworth and Co., Ltd.	1	3 3/16 — 3 7/16
5	2/-	Do. 4% Cum. Pref.. ..	5	5⅜— 5⅝
100	4%	Do. 4% 1st Mort. Dbs. Rd.	100	102 —104
100	4½%	Aveling and Porter, Ltd., 4½% Reg. Mt. Debs. Red.	100	96 — 99
1	1/7½	Babcock and Wilcox, Ltd., Ord. ..	1	3½— 3⅝
1	7½d.	Do. ,, 6% Cum. Pref.	1	1½— 1⅝
5	3/-	Baker (Joseph) and Sons, Ltd., 6% Cum. Pref...	5	5 — 5½
1	6⅝d.	Baldwins, Ltd., 5½% Cum. Pref. ..	1	1 — 1⅛
Stk	4½%	Do. 1st Mt. 4½% Deb. Stk. Red.	100	101 —103
4½	2/8¾	Barrow Hæmatite Steel Co., Ld., O.	4½	1 9/16 — 1 11/16
4½	6/-	Do. do. Cum 2nd. Pref.	4½	4½— 4¾
5	2/6	Bayliss, Jones and Bayliss, Ltd., 5% Cum. Pref. Shares	5	4¾— 5¼
100	—	Beardmore (Wm.) & Co., Ltd., 4½% 1st Mt. Debs., Red., Scrip 50% pd	—	100 —102
10	6/-	Bell Brothers, Ltd., 6% Cum. Pref.	10	11⅝— 11⅞
Stk	4%	Do 4% Deb. Stock, Red.	100	99 —101
1	1/-	Beyer, Peacock and Co., Ltd., Ord.	1	⅝— 11/16
1	6⅝d.	Do. 5½% Cum Pref.	1	25/32— 27/32
Stk	4½%	Do. 4½% Red. Deb. Stock	100	94 — 97
1	6d.	Bolckow, Vaughan and Co., Ltd., O. Nos. 1-1,629,760	1	1 — 1 1/16
1	3⅝d.	Do. Nos. 1,639,101-3,500,000	12/-	21/32— 23/32
1	4½d.	Brown (John) and Co., Lim., Ord., Nos. 1-1,160,000	15/-	1¼— 1⅜
1	6d.	Do. Ord., Nos. 1,160,001-1,750,000	1	1 25/32— 1 27/32
10	5/-	Do. 5 % Cum. Pref.	10	11¼— 11¾
5	2/6	Cammell, Laird & Co., Ltd., Ord.	5	8¾— 9
5	2/6	Do. 5% Cum. Pref. ..	5	5⅜— 5⅝
1	1/6	Clayton & Shuttleworth, Ltd., Ord.	1	31/32— 1 1/32
5	2/6	Do. 5% Cum. Pref.	5	5¼— 5½
Stk	4%	Do 4% 1st Mort. Db. Stk. Red	100	100 —102
10	30/-	Consett Iron Co., Ltd., Ord.. ..	7½	32 — 33
10	10/-	Crossley, Bros., Ld., Ord. 40340/97370	10	16¼—16¾
10	5%	Do. 5% Cum. Pref.	10	11¼—11¾
1	2/6	Delta Metal, Ltd. Shares	1	2⅛— 2¼
1	3⅝d.	Dorman, Long & Co., Ltd.	1	23/32— 25/32
Stk	4%	Do. 4% 1st Mort. Perp. Deb. Stk.	100	91 — 94
5	3/-	Dunderland Iron Ore Co., Ltd., 6% Cum. Pref. and Participating..	5	3¼— 3½
1	9⅜d.	Dunlop (James) & Co., Ltd., Ord...	1	⅝— ¾
1	7½d.	Do. 6% Cum. Pref. ..	1	15/16 - 1 1/16
13	12/-	Ebbw Vale Steel, Iron & Coal Co., Ltd.	13	9 — 10
13	12/-	Do. do. do.	10	7¾— 8
10	8/-	Elliott's Metal, Ltd.	8	4½— 5½
10	5%	Do. Cum. Pref. 5%	10	8¾— 9¼
Stk	4%	Do. Deb. 4%	100	94½ — 96½
10	6/-	Fairfield Shipbuilding & Engng. Co., Ltd., 6% Cum. Pref. ..	10	10½— 11
Stk	4½%	Do. 4½% Mort. Deb. Stk. Red.	100	97 —100
10	10%	Fleming & Ferguson, Ltd, Ord. Nos. 1/9000..	10	12 —12¼
10	5%	Do. 5% Cum. Pref. Nos. 9001/15000	10	9¾—9⅞
3	3/-	Fraser & Chalmers, Ltd., Ord. ..	3	4⅝— 4⅞
3	1/6	Do. 7½% Cum. Pref.	3	5¾— 6¼
10	5%	Galloways, Ltd., 5% Cum. Pref. 18001/28000	10	6 — 7
Stk	4%	Do. 4% 1st Mort Deb Red..	100	90½—91½
10	—	Greenwood & Batley, Ltd., Ord. ..	10	
10	7%	Do. 7% Cum. Pref.	10	
1	10%	Guest, Keen & Nettlefolds, Ltd. Ord.	1	2¼— 2⅜
5	2/6	Do. 5% Cum. Pref.	5	5⅞— 6⅛
Stk	4%	Do. 4% Irred. Mort. Deb. Stk	100	105 —107
5	2/6	Gwynnes, Ltd., 5% Cum. Pref. ..	5	2 — 3
1	1/-	Hadfield's Steel F'dry Co., Ld., Ord.	1	3⅜— 3½
10	4/6	Do. 4½% Cum. Pref... ..	10	10½— 11
5	3/-	Hall (J. & E.), Ltd. 6% Cum. Pref...	5	5 — 5½*
1	1/6	Harvey United Steel Co., Ltd. ..	1	1 5/16— 1 7/16
10	7½%	Hawthorn, Leslie & Co., Ltd. Ord.	10	11 —11½
5	7/-	Head, Wrightson & Co., Ltd. ..	5	4¾— 5¼
1	7½d.	Hill (Richard) & Co. (1899) Ld., Ord.	1	⅝— ¾
5	3/-	Do. 6% Cum. Pref.	5	4¾— 5
10	6/-	Hornsby (Richard) & Sons, Ld., Ord.	8	5¾— 6¼

ENGINEERING, IRON, AND STEEL COMPANIES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
750,000	1	6d.	Howard & Bullough, Ltd., Ord. ..	1	1 11/16—1 13/16
25,000	10	6/-	Do. 6% Pref. (Non-Cum.) ..	10	12¼— 12¾
£250,000	Stk	4%	Do. 4% Deb. Stk., Red. after 1905	100	98 —101
37,500	10	20	Kynoch, Ltd.	10	19 — 20
49,537	10	5%	Do. Cum. Pref. 5%	10	10⅞— 11⅛
300,000	1	4½d	Lambert Bros., Ltd., Ord.	1	⅝— ⅞
50,000	5	2/9	Do. 5½% Cum. Pref... ..	5	4 — 4½
40,000	3	2/1½	Leeds Forge Co., 7% Cum. Pref. ..	3	3¾— 4¼
200,000	1	7½d.	Lysaght (John), Ltd., 6% Cum. Pf.	1	1 5/16— 1 7/16
£300,000	Stk	4½%	Do 4½% 1st Mt. Deb. Stk., Red.	100	108 —110
40,000	10	5/-	Mather & Platt, Ld., 5% Cum. Pref	10	11 — 11½
210,000	1	6d.	Measures Bros., Ltd., Ord.	1	11/16— 13/16
75,000	1	6⅝d.	Do. 5½% Cum. Pref.	1	13/16— 15/16
£75,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	94 — 97
21,943	5	2/6	Muntz Metal, Ltd.	5	5 — 5¼
14,248	5	5%	Do. Pref. 5%	5	5⅛— 5⅜
5,000	62½	47/6	Nantyglo and Blaina Iron Works, Ltd., 8% Cum. Pref.	62½	74 — 76
73,000	10	5/-	N. Brit. Loco. Co., Ltd., 5% Cm. Pf.	10	11⅞— 12⅛
80,000	5	—	North-Eastern Steel Co., Ltd., Ord.	5	—
£250,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	90 — 93
122,000	5	2/-	Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B"	5	3⅞— 4⅛
50,000	5	3/-	Do. 6% Cum. Pref. "A" ..	5	5¾— 6¼
70,000	10	6/-	Pease & Partners, Ltd., Ord. ..	10	9¼— 9¾
£400,000	Stk	4%	Do. 4% Perp. Deb. Stock ..	100	97 —100
20,000	5	3/-	Peebles (Bruce) & Co., Ld., 6% Cm.P.	5	4¾— 5
65,000	1	—	Pooley (Henry) & Son., Ltd., Ord ..	1	3/6—4/-
13,000	5	—	Do. 5½% Cum. Pref.	5	2⅞— 3⅛
230,000	1	—	Projectile Co. (1902), Ltd., Ord. ..	1	½— ⅝
126,938	5	2/-	Rhymney Iron Co., Ltd.	5	1¾— 2
73,062	5	2/-	Do. New	5	1½— 1¾
£330,000	—	5%	Do. 5% Mort. Deb., Red. ..	100	99 —102
350,000	1	7½d.	Richardsons, Westgarth & Co., Ltd., 6% Cum. Pf. ..	1	⅞— 15/16
£350,000	Stk	4½%	Do. 4½% Perp. Deb. Stock ..	100	94 — 96
35,000	10	12/-	Ruston, Proctor & Co., Ltd... ..	10	9¼— 9¾
275.000	1	6d.	Scott (Walter), Ltd., Ord.	1	⅞— 1
300,000	1	7½d.	Do. 6% Cum. Pref. ..	1	1— 1⅛
£300,000	Stk	4%	Do. 4% Perp. Deb. Stk.	100	94 — 96
£115,300	100	5%	Shelton Iron, Steel and Coal Co., Ld. 1st Charge 5% Debs.. Red ..	100	91 — 94
£97,900	100	6%	Do. 6% 2nd Mort. Debs., Red.	100	91 — 95
250,000	1	1/-	South Durham Steel & Iron, Ltd. Or.	1	⅝— 11/16
300,000	1	7½d.	Do. 6% Cum. Pref...	1	13/16— ⅞
£300,000	Stk	4½%	Do. 4½% Per. Deb. Stock	100	89 — 92
49,560	10	2½%	Steel Co. of Scotland Ord. 1/49560..	9	5¼— 5⅝
£125,240	Stk	—	Do. 5% Trust Mort. Deb. ..	100	106½—107½
25,000	10	—	Stephenson (Robert) & Co., Ltd., Or.	10	2¼— 2¾
25,000	10	5/6	Do. 5½% Cum. Pref. ..	10	4¼— 4¾
£250,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	76 — 78
85,000	10	9/-	Stewarts & Lloyds, Ltd., Ord. ..	10	16¾— 17¼
55,000	10	6/-	Do. 6% Cum. Pref.	10	14¼— 14¾
634,782	1	4.69d.	Swan, Hunter & Wigham-Richardson, Lim. Ord.	1	⅞— 1
538,845	1	6d.	Do. 5% Cum. Pref.	1	15/16— 1 1/16
£240,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Red	100	98 — 101
300,000	1	6d.	Thames Iron Works, Shipbuilding & Engineering Co., Ltd., 5% Cum. Pf.	1	½— 9/16
£200,000	100	4%	Do. 4% Irredeem. 1st Mort. Deb.	100	67 — 71
£160,000	1	7½d.	Thornycroft (John I.) & Co., Ltd. 6% Cum. Pref.	1	15/16— 1 1/16
10,000	10	5/-	Tylor (J.) & Sons, Ltd. 5% Cum. Pf.	10	9½— 10
$508495200	$100	$½	United States Steel Corp. Com. Stk.	$100	31½— 31¾
$360314100	$100	$1¾	Do. 7% Cum. Pref. Stock	$100	97¾— 98¼
$162268000	$1000	5%	Do. 10-60yr. 5% Skg. Fd. G. Bds.	$1000	95 — 97
3,350,000	1	1/-	Vickers, Sons & Maxim, Ltd. Ord..	1	2 7/16— 2 9/16
750,000	1	6d.	Do. 5% Non-Cum. Pref. ..	1	1⅛— 1¼
£750,000	Stk	5%	Do. 5% Non-Cum. Pref. Stock.	100	114 —117
£1,250,000	Stk	4%	Do. 4% 1st. Mort. Deb. Stk. Red.	100	105 —107
£1,000,000	100	4½%	Do. 4½% 2nd Mort. Debs., Red.	100	104 —106
225,000	1	1/2⅝	Weardale Steel, Coal & Coke, Ltd., Def. Ord.	1	13/16— 15/16
500,000	1	7½d.	Do. 6% Cum. Pref. Ord. ..	1	⅞— 1*
£300,000	Stk	4%	Do. 4% Perpetual Deb. Stock	100	85 — 89
7,637	5	2/9	Weldless Steel Tube, Ltd., Cum. Pref. 5½	5	4¾— 4⅞
300	Stk	4½%	Do. Mort. Deb. 4½%	100	91 — 97
66,666	5	3/.	Willans & Robinson, Ord.	5	1½— 2½
66,666	5	3/-	Do. 6% Cum. Pref.	5	3 — 4
£246,641	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red	100	74 — 79
£150,000	Stk	4½%	Yorkshire Iron & Coal Co., Ltd., 4½% 1st Mort. Deb. Stk. Red.	100	81 — 86

Stocks and Shares marked * are quoted ex-dividend.

II.—ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
70,000	1	6d.	Alliance Elec. Co., Ltd. 5% Cum. Pf.	1	⅝— ⅞
125,000	1	7½d.	Aron Elec. Meter Ltd., 6% Cum. Pf.	1	7/16— 9/16
120,000	1	9⅜d.	Bell's Asbestos Co., Ltd.	1	11/16— 13/16
100,000	5	4/-	British Insulated & Helsby Cables Ltd., Ord. ..	5	5¼— 5¾
100,000	5	3/-	Do. 6% Cum. Pref.	5	5 —5½*
£500,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Rd.	100	101 —104
£200,000	Stk	4½%	British Thomson-Houston Co., Ltd., 4½% 1st Mort. Deb. Stk. Red. ..	100	101 —103
400,000	5	3/-	British Westinghouse Electric and Manufac. Co., Ltd., 5% Pref. ..	5	2½— 2¾
£616,358	Stk	4%	Do. 4% Mort. Deb. Stk. Red...	100	86 — 88
105,731	2	2/-	Brush Elec. Enging. Co., Ltd., Ord..	2	⅜— ⅝
150,000	2	2/4⅘	Do. 6% Pref.	2	1¼— 1½
£125,000	Stk	4½%	Do. 4½% Perp. 1st Deb. Stk...	100	93 — 96
£125,000	Stk	4½%	Do. 4½% Perp. 2nd Deb. Stk.	100	75 — 78
35,000	5	5/-	Callender's Cable & Constn. Ltd. Ord.	5	9½ - 10
40,000	5	2/6	Do. 5 % Cum. Pref.	5	5¼ - 5½
£200,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Red.	100	105 —107
85,000	3	1/6	Crompton & Co., Ltd...	3	2¼— 2½
£100,000	—	5%	Do. 5% 1st Mort. Reg. Debs.	100	93 — 98
52,000	5	10/-	Dick, Kerr & Co., Ltd., Ord. ..	5	8 — 8½
61,000	5	3/-	Do. 6% Cum. Pref.	5	5¾— 6
£300.000	Stk	4½%	Do. 4½% Deb. Stock, Red. ..	100	105 —107
233,334	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	1⅛— 1⅜
£233,334	Stk	4%	Do. 1st Mort. 4% free. Deb. Stk.	100	105 —108
99,261	5	1/6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	3	⅝— ⅞
17,139	5	2/6	Do. "A" Shares Nos. 01-017,139	5	1 — 1½
£344,023	Stk	4%	Do. 4% Deb. Stock Red. ..	100	77 — 82
£100,000	Stk	5%	Do. 5% Second Deb. Stk. Red.	100	79 — 84
112,100	2	1/7½	Electric Construction Co., Ltd. ..	2	1⅛— 1¼
31,390	2	2/9⅗	Do. 7% Cumulative Pref. ..	2	2¼— 2½
£200,000	Stk	4%	Do. 4% Perp. 1st Mt. Deb. Stk.	100	97 — 99
10,248	10	7/6	Evered and Co., Ltd...	10	13 — 15
£100,000	Stk	5%	Ferranti, Ltd., 5% 1st Mort. Deb. Stock, Red...	100	90 — 95
125,000	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9½— 10
£200,000	Stk	4%	Do. 4% 1st. Mt. Deb. Stk., Red.	100	91 — 96
35,000	5	5/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	10¾— 11¼
35,000	5	2/3	Do. 4½% Cum. Pref... ..	5	5⅛— 5⅜
£50.000	Stk	4½%	Do. 4½% Mt. Deb. Stk. Red.	100	110 —112
50,000	10	5/-	India Rubber, Gutta Percha & Telegraph Works Co., Ltd.,	10	15 — 16
£300,000	100	4%	Do. 1st Mort. Deb. Red. ..	100	99 —102
7,500	10	—	Parker, Thos., Ltd.	10	6½— 7
100,000	1	3%	Scott (Ernest) & Mountain, Ld., Ord.	1	16/-—16/6
37,350	12	12/-	Telegraph Construction and Maintenance Co., Ltd.	12	38 — 40
£150,000	100	4%	Do. 4% Deb. Bonds	100	101½-103½

III.—ELECTRIC TRACTION.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
120,000	5	3/-	Anglo-Argentine Trams Co., Ld., Or.	5	8⅜— 8⅝
260,007	5	2/6	Do. 5% Cum Pf.	5	5⅝— 5⅞
£230,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888 ..	100	140 —143
20,000	10	6/-	Barcelona Trams Co., Ltd., Ord. ..	10	11¾— 12¼
10,000	10	5/-	Do. 5% Cum Pf. Shares	10	9 — 10
£46,300	100	5%	Do. 5% Debs., Red. ..	100	99 —102*
£191,326	Stk	4½%	Do. 4½% Red. Deb. Stk.	100	96 —100*
75,606	1	—	Bath Elec. Trams. Ld., Pf. Or. ..	1	11/16— 13/16
59,394	1	11·49d	Do. 5% Cum. Pf. ..	1	13/16— 1 1/16
75,000	5	—	Brisbane Electric Tram Investment Co., Ltd., Ord... ..	5	1¼— 1¾
75,000	5	2/6	Do. 5% Cum. Pf. ..	5	3¾— 4¼
£425,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	94 — 98
£200,000	Stk	6%	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	100 —103
		%	Pref. Ord. Stock	100	100 —103
133,301	10	6/-	Brit. Electric Traction, Ltd., Ord.	10	9¼— 9¾
156,437	10	6/-	Do. 6% Cum. Pref... ..	10	11⅛— 11⅝
£1,000,000	Stk	5%	Do. 5% Perp. Deb. Stk. ..	100	119 —121
£250,000	Stk	4½%	Do. 4% 2nd Deb. Stk. Red..	100	97 — 99
100,000	5	1/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	3⅞— 4⅛
40,500	5	3/-	Do. "A" 6% Cum Pref. ..	5	5¾— 6
27,000	5	3/-	Do. "B" do.	5	5⅜— 5⅝

ELECTRIC TRACTION.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Clos Pri
£200,000	Stk	5%	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	94 -
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	99 -
102,268	5	3/-	Calcutta Tramways Co., Ltd. ..	5	8⅞-
£350,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	106 -
480,000	1	6d.	Cape Electric Tramways, Ltd. ..	1	1⅝-
40,000	5	2/6	City of Birmingham Trams Co., Ltd. 5 % Cum. Pref.	5	4⅞-
£300,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	101 -
£120,000	Stk	5%	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	101 -
60,000	10	6/-	Dublin United Trams. Co. (1896), Ltd., Ord. ..	10	13 -
59,987	10	6/-	Do. 6% Pref...	10	15½-
30,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	3¼-
£150,000	Stk	4%	Do. 4% Deb. Stock.. ..	100	90 -
125,000	10	5/-	London United Trams. (1901), Ltd., 5% Cum. Pref.	10	10⅝-
£1,031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	104 -
£50,000	Stk	5%	Madras Electric Trams (1904), Ltd., 5% Deb. Stock, Red.	100	101 -
314,016	1	—	Metropolitan Elec. Trams, Ltd., Def.	1	11/32
500,000	1	6d.	Do. 5% Cum. Pref... ..	1	⅞
£350,000	Stk	4½%	Do. 4½% Deb. Stock, Red.	100	104 -
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	½-
110,923	8	2/9⅗	North Metropolitan Tramways Co..	8	4¾-
£150,000	100	3½%	Do. 3½% Mort. Debs.	100	90 -
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red..	100	102 -
24,500	10	10/-	Potteries Elec. Traction Co., Ld., Or.	10	8 -
24,500	10	5/-	Do. 5% Cum. Pref. ..	10	8½-
£220,000	Stk	4½%	Do. 4½% Deb. Stk., Red.	100	99 -

IV.—ELECTRIC LIGHTING AND POWER

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Clo Pri
7,500	10	16/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. ..	10	12 -
7,500	10	4/6	Do. 4½% Cum. Pref. ..	10	9½-
7,500	10	6/-	Do. 6% Cum. Second Pf. ..	10	11 -
£70,000	Stk	4½%	Do. 4½% Deb. Stock Red ..	100	104 -
14,000	5	2/-	Bromley (Kent) Elec. Lt. & Pr. Co. Ld	5	5½-
£50,000	Stk	4½%	Do. do. 4½% 1st Deb. Stk. Red.	100	101 -
27,507	5	4/6	Brompton & Kensington Elec. Supply Co., Ltd. Ord. ..	5	10½-
12,493	5	3/6	Do. 7% Cum. Pref. Shares..	5	10¼-
60,000	5	3/-	Calcutta Elec. Sup. Cor. Ltd., Ord..	5	8½-
£288,782	Stk	4%	Central Elec. Sup. Co., Ltd., 4% Gua. Deb. Stk. ..	100	105 -
70,000	5	4/-	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord... ..	5	8¼-
80,000	5	2/3	Do. do. 4½% Cum. Pref...	5	5½-
£350,000	Stk	4%	Do. do. 4% Deb. Stk. Red.	100	101 -
44,436	5	2/3	Chelsea Elec. Sply. Co., Ltd., Ord.	5	6¼-
£150,000	Stk	4½%	Do. do. 4½% Deb. Stk., Red	100	108 -
70,595	10	5/-	City of London El. Lghtg. Co., Ld., O.	10	12 -
40,000	10	6/-	Do. 6% Cum. Pref... ..	10	13½-
£400,000	Stk	5%	Do. 5% Deb. Stk., Red ..	100	122 -
£300,000	Stk	4½%	Do. 4½% 2nd Deb. Stk., Red	100	102 -
40,000	10	4/-	County of London Elec. Supply Co., Ltd., Ord.	10	9 -
30,000	10	6/-	Do. 6% Cum. Pref.	10	12 -
£400,000	Stk	4½%	Do. 4½% Deb. Stk., Red. ..	100	108 -
70,000	5	2/6	Edmundson's Elec. Cor. Ltd., Ord.	5	6¼
70,000	5	3/-	Do. 6% Cum. Pref.	5	6 -
£300,000	Stk	4½%	Do. 4½% 1st Mort. Db. Stk. Reg	100	106 -
£80,000	Stk	5%	Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. Stk. Red.	100	86 -
10,000	5	2/-	Folkestone Elec. Supply Co., Ld., O.	5	5½
£50,000	Stk.	4½%	Do. 4½% 1st Deb. Stk., Red.	100	101
15,000	10	—	Havana Electricity Co., Ltd... ..	10	9½
13,000	5	3/6	Hove Elec. Lighting Co., Ltd., Ord.	5	7½
£50,000	Stk	4½%	Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock, Red.	100	100
150,000	1	—	Kalgoorlie Electric Power & Lighting Corp, Ltd., 6% Cum. Pref.	1	3/16
21,000	5	5/-	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord. ..	5	13

Stocks and Shares marked * are quoted ex-dividend.

ELECTRIC LIGHTING AND POWER.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£135,000	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	102 —104
111,000	3	—	London Elec. Supply Corp., Ld., Ord.	3	2⅜ — 2⅝
60,000	5	3/-	Do. 6% Pref.	5	5⅜ — 5⅞
£371,895	Stk	4%	Do. 4% 1st Mort. Db. Stk., Red.	100	96 — 98
100,000	10	9/-	Metropolitan Elec. Sup. Co., Ld., Or.	10	18 — 18½
76,121	5	2/3	Do. 4½% Cum. Pref.	5	5¼ — 5⅝
220,000	Stk	4½%	Do. 4½% 1st Mort. Db. Sk., Red.	100	110 —115
250,000	Stk	3½%	Do. 3½% Mort. Deb. Stk., Red.	100	96 — 98
£250,000	—	4½%	Midland Elec. Corp. for Power Distribution, Ld., 4½% 1st Mort. Deb.	100	94 — 97
10,852	10	6/-	Notting Hill Elec. Ltg. Co. Ltd. Ord.	10	14½— 15
£59,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	102 —104
16,500	5	2/6	Oxford Electric Co. Ltd., Ord. ..	5	6⅛— 6⅝
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	98 —100
£84,700	100	4½%	Royal Elec. Co. (of Montreal) 4½% 20-yr. 1st Mort. Deb	100	100 —102
40,000	5	5/-	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	13¾—14¼
20,000	5	3/6	Do. 7% Pref...	5	8½— 9
£150,000	Stk	3½%	Do. 3½% Deben. Stock, Red	100	98 —100
12,000	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2¾— 3¼
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	83 — 87
65,000	5	3/-	South London Elec. Sup. Co., Ltd. O.	5	4¼— 4½
100,000	1	—	South Metropolitan Elec Light & Power Co., Ltd. Ord.	1	⅞ — 1
50,000	1	8⅔d.	Do. 7% Cum. Pref.	1	1⅜— 1 7/16
£100,000	Stk	4½%	Do. 4½% 1st Deb. Stock Red.	100	107 —110
50,000	5	2/6	Urban Electric Supply Co., Ltd., O.	5	5 — 5⅛
30,000	5	2/6	Do. 5% Cum Pref.	5	5 1/16—5 3/16
£200,000	Stk	—	Do. 4½% 1st Mort. Deb. Stk. Red	100	105 —107
110,000	5	6/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	13 — 13½
28,151	5	2/6	Do. 5% Cum. Pref.	5	6 — 6½

V.—TELEGRAPH & TELEPHONE COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£34,800	100	4%	African Direct Tel. Co., Ld., 4% Mt. Debs. (Series A), Red.	100	99 —102
25,000	10	—	Amazon Telegraph Co., Ld... ..	10	1 — 1½
£763,580	Stk	12/6	Anglo-American Tel. Co., Ltd., Ord.	100	58 — 60
£3,118,210	Stk	25/-	Do. 6% Preferred Ordinary	100	105 — 107
£3,118,210	Stk	2/-	Do. Deferred Ordinary ..	100	12¼— 12½
44,000	5	3/-	Chili Telephone Co., Ltd.	5	6⅛— 6⅜
$15,000,000	$100	$2	Commercial Cable Co., Capital Stk.	$100	170 —190
£1,903,856	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	95 — 97
16,000	10	5/-	Cuba Submarine Tel. Co., Ld., Ord.	10	8¾— 9¼
6,000	10	10/-	Do. 10% Preference	10	16½— 17½
6,000	5	2/-	Direct Spanish Telegraph Co., Ord.	5	3⅜— 3⅝
		5/-	10% Cum. Preference	5	7¾— 8¼
£30,000	50	4½%	Do. 4½% Debs...	50	100-102%
60,710	20	3/-	Direct U.S. Cable Co., Ltd... ..	20	11 —11½
£85,800	100	4½%	Direct West India Cable Co., Ltd., 4½% Reg. Debs.	100	99 —101
£300,000	100	4%	East. & S. African, Ld., 4% Mt. Dbs.	100	99 —101*
£200,000	25	4%	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)..	25	100-102%
300,000	10	2/6	Eastern Extension, Australasia and China, Ltd...	10	13½— 14
£602,400	Stk	4%	Do. 4% Mort. Deb. Stk., Perp.	100	104 —106*
£4,000,000	Stk	25/-	Eastern Tele. Co., Ltd., Ord. ..	100	135 —138
£2,000,000	Stk	17/6	Do. 3 % Pref.	100	87 — 89
£1,836,814	Stk	4%	Do. 4% Mort. Deb.	100	105 —107
150,000	10	5/-	Great Northern Telegraph Co., Ltd., (of Copenhagen) ..	10	29¾— 30¼
£58.700	100	4½%	Halifax and Bermudas Cable Co., Ltd., 4½% 1st. Mort. Debs. Red.	100	99 —101
17,000	25	12/6	Indo-European Tele. Co., Ltd. ..	25	45 — 47
72.680	1	7½d.	Monte Video Telephone Co., Ltd., O.	1	13/16— 15/16
£1,983,333	Stk	6%	National Telephone Co., Ltd., Pref.	100	108½—109½
£1,966.667	Stk	5%	Do. Deferred	100	108—110
250,000	5	2/6	Do. 5% Non-Cum. 3rd Pref.	5	5¼ — 5½
£2,000,000	Stk	3½%	Do. 3½% Deb. Stk., Red. ..	100	96 — 98
£689,593	Stk	4%	Do. 4% do. do. ..	100	101½—103½
179,313	1	7½d.	Oriental Telephone & Elec. Co., Ltd.	1	1 — 1⅛
50,000	1	7⅕d.	Do. 6% Cum. Pref.	1	1⅛— 1¼
£100,000	100	4%	Pacific & European Tel. 4% Guar. Debs. Red...	100	96 — 99
11,839	8	4/-	Reuter's Telegram Co., Ltd. ..	8	7 — 7½
58,000	5	3/-	United River Plate Telep. Co., Ltd.	5	6¾— 7¼
40,000	5	2/6	Do. 5% Cum. Pref.	5	5 — 5¼
£179,947	Stk	5%	Do. 5% Deb. Stock, Red. ..	100	105—107
15,609	10	4/-	W. African Telegraph Co., Ltd. ..	10	7¼— 7¾
£30,008	2½	—	West Coast of America, Ltd. ..	2½	5/16— 7/16
150,000	100	4%	Do. 4% Deb. Guar. by West. Tel.	100	99 — 101

TELEGRAPHS AND TELEPHONES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name	Paid up.	Closing Prices.
88,321	10	6d.	W. India & Panama Teleg. Co., Ld., Or.	10	⅝— ¾
34,563	10	6/-	Do. 6% Cum. 1st. Pref. ..	10	7¼— 7¾
4,669	10	6/-	Do. 6% Cum. 2nd Pref. ..	10	6¾— 7¼
£80,000	100	5%	Do. 5% Deb.	100	101 —103
207,930	10	3/-	Western Telegraph Co., Ltd. ..	10	13½— 14
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	101 —103
518,945	Stk	4%	Do. 4% Deb. Stock, Red. ..	100	100½—102½

VI.—SHIPPING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
32,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 5½% Cum. Pref.	10	8½— 9
£325,000	Stk	4½%	Do. 4½% Red. 1st Mort. Deb. Stk.	100	99 —101
£672,900	Stk	4½%	British & African Stm. Nav. (1900) Ltd., 4½% 1st Mort. Deb. Stk., Red.	100	93 — 95
40, 000	10	5/6	Bucknall Steamship Lines, Ltd., 5½% Cum. Pref.	10	6 — 6½
£600,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk.	100	73 — 76
£750,000	Stk	4½%	Clan Line Steamers, Ltd., 4½% Deb. Stk. Red. ..	100	98 —100
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000..	20	13¾— 14¼
40,000	20	8/-	Do. Nos. 60,001-100,000	10	6 — 6½
£464,430	Stk	4½%	Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. ..	100	101 —103
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord...	1	1⅛— 1¼
25,328	7½	4/7	Gen. Steam Navigation Co., Ld., Ord.	7½	4¼— 4¾
36,758	8	4/9⅗	Do. Non-Cum. 6% Pref.	8	7¼— 7¾
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	97 — 99
55,000	5	1/3	Houlder Line, Ltd., Ord.	5	3 — 3¼
40,000	5	2/9	Do. 5½% Cum. Pref.	5	3¼— 3¾
£200,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk. Red.	100	83 — 86
141,500	10	5/-	Leyland (Fredk.), & Co.. (1900), Ltd., 5% Cum. Pref. ..	10	4½— 5
£1,160,000	Stk	5 %	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. ..	100	126 —129
£1,160,000	Stk	19%	Do. do. Deferred ..	100	218 —221
15,000	100	30/-	Royal Mail Steam Packet Co. Ord..	60	26 — 27
39,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref..	5	4¾— 5¼
39,075	5	2/6	Do. "B" Ord...	5	4 — 4½
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord..	10	8 — 8½
24,000	10	4/6	Do. 4½% Cum. Pref... ..	10	9¾— 10¼
£1,008,894	Stk	4%	Do. 4% Debenture Stk., Red.	100	99 —101

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
60,000	1	9⅗d.	Chadburn's (Ship) Tele. Ltd., Ord...	1	⅞— 1⅛
£750,000	Stk	5%	General Hydraulic Power Co., Ltd.	100	138 —143
12,500	10	10/-	Oakey (John) and Sons, Ltd., Ord..	10	24 — 26
10,000	10	6/-	Do. do. 6% Cum. Pf.	10	14 — 15
183,538	1	6·3d.	Power Gas Corp., Ltd., Ord., Nos. 66,463-250	15/-	5/16— 7/16
66,462	1	8·4d.	Do. do. Nos. 1 66,462	1	9/16— 11/16
135,000	1	6d.	Waygood (R.) & Co., Ltd., Ord. ..	1	1 1/16— 1 3/16
135,000	1	7⅕d.	Do. 6% Cum. Pref. ...	1	1⅛— 1¼

RAILWAY CARRIAGE & WAGON COMPANIES.

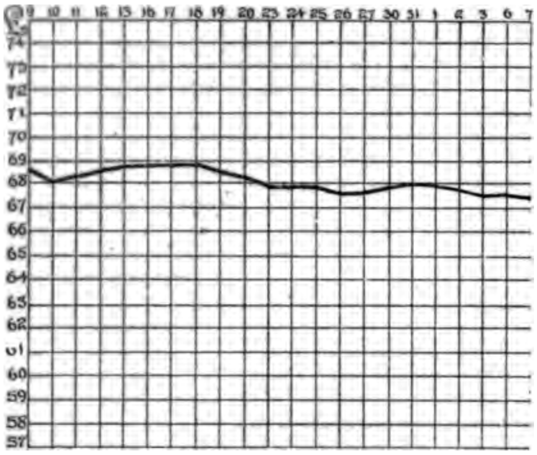
Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices
10,000	10	7/6	Birm. Railway-Car, & Wagon, L., 1-10,000	10	21¼— 21¾
8,739	10	3/-	Do. Second Issue 1-8,739....	4	8¼— 8¾
10,000	10	6/-	Do. Cum. Pref. 6% 1-10,000..	10	13 — 13½
30,111	7	7/-	Gloucester Rail.-Car & Wagon, Ld., A, 1-29,861 & 49,751-50,000	7	9 — 9½
44,889	7	3/6	Do. B, 29,862-49,750, 50,001-75,000	7	4 — 4½
14,567	10	1/3	Lancashire Wagon, Ord.	2	2 7/16—2 9/16
4,150	10	5%	Do. do.	10	10¾—10 13/16
781,808	1	9d.	Metropolitan Amalgamated Rail.-Carriage & Wagon, Ld., 1-784,808	1	41 — 42
164,288	1	6d.	Do. Cum. A Pref. 5% 1-164,288	1	23/6—24/6
235,000	1	7⅕d.	Do. Cum. B Pref. 6% 1-235,000	1	28/3—28/9
20,000	20	20/-	Midland Rail.-Car. & Wagon, Ld., 1-20,000	10	19 — 20

Stocks and Shares marked * are quoted ex-dividend.

THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM JANUARY 9TH TO FEBRUARY 7TH, 1905.

COPPER.



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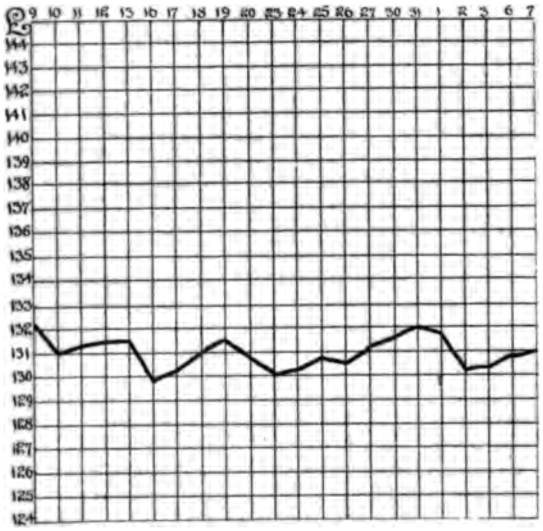

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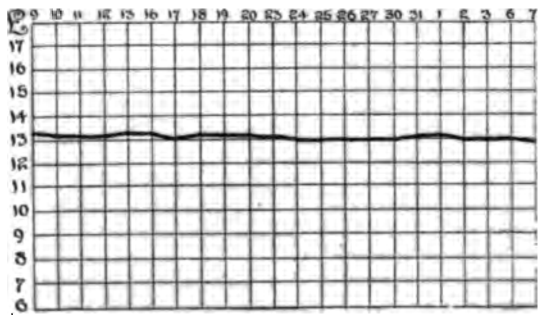

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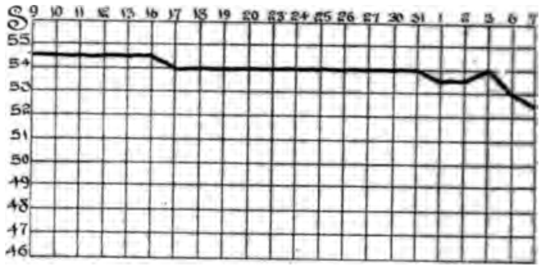

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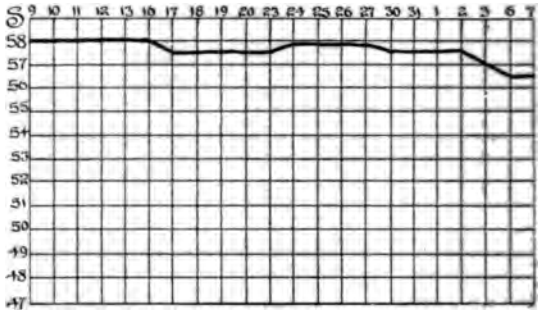
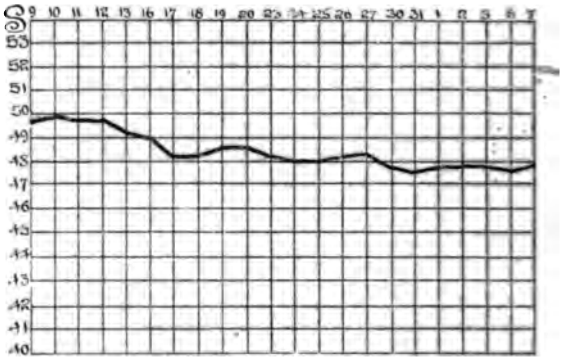


CLEVELAND.



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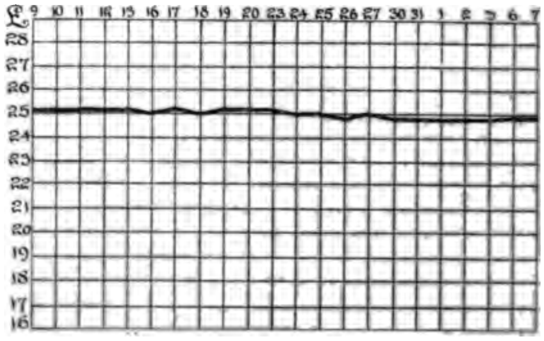


PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

MARKET REPORT.

Wednesday, February 8th, 1905.

COPPER has been weaker, although on balance quotations show little alteration. There has been practically no change in the statistical position, but less sanguine views of the future of the metal are prevalent, it being argued that the advance in price during the past three months has gone a long way to discount the good position. Messrs. Merton and Co.'s circular does not reflect this view. It is pointed out that consumers here as well as abroad have again been buying for immediate requirements, with the result that in metal for early delivery the market is rather short. The position is one where the task of predicting the future course of quotations is a difficult one, but an advance in the price of the metal appears probable.

Tin has been an active market. With scarcity in New York there has been some good American buying of prompt metal, with the result that quotations advanced to an extent which checked buying orders. A break in the market followed, but was to some extent stayed by the satisfactory statistics. The price receded again yesterday.

Lead has exhibited few features of interest. At the beginning of the week there was a tendency to firmness owing to the absorption of spot parcels, but quotations eased off when consumers had satisfied their immediate requirements. The closing prices are £12 12s. 6d. foreign and £12 17s. 6d. English.

The market for Spelter is a shade easier, the result of slower inquiries, but the labour trouble in Silesia is regarded as a bull point and a recovery appears imminent.

In the Iron and Steel section, the speculative markets in London and Glasgow have been active but prices have receded on balance, operators being in a realising mood. Poor shipments and the growing stocks in public stores have been the main causes of speculative sales. The reports from trade centres are not however unsatisfactory. At Barrow there are indications of a revival in the hematite trade, and Glasgow reports the steel trade more active on the revival in shipbuilding. At Birmingham the tone is steady, and Sheffield correspondents, while reporting continued inactivity in iron, give a good account of the heavy steel trade.

Coal shows an improved tone, more satisfactory reports coming to hand from both Cardiff and Newcastle.

IRON, STEEL, PIG-IRON, &c.

SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as follows. Prices delivered in Glasgow or equal :—

	£	s.	d.
Steel :			
Siemens' Steel Plates, Marine Boiler Quality	6	15	0
,, ,, ,, Land ,, ,,	6	17	6
,, ,, ,, Ship Quality Plates	5	17	6
Siemens' Steel Bars, Boiler Quality	6	17	6
,, ,, ,, Ship ,,	6	7	6
,, ,, Angles	5	7	6
Manufactured Iron :			
Bars—Dalzell	6	2	6
,, Best	6	12	6
,, ,, Horseshoe	6	12	6
,, Angle	6	2	6
,, Best Angle	6	12	6
,, Best Best	7	2	6
,, Extra Best	7	12	6

Usual terms and extras. Special rates for delivery in England and export. The above prices subject to alteration without notice.

The Glasgow Iron and Steel Co., Ltd., Wishaw, quote as under (prices are delivered Glasgow or equal) :—

	£	s.	d.	
Steel Angles (Glasgow ♛ Steel)	5	8	9	per ton.
Steel Ship Plates (Glasgow ♛ Steel)	5	18	9	,,
Steel Bars, Ship Quality (Glasgow ♛ Steel)	6	8	9	,,
Steel Bars, Boiler Quality (Glasgow ♛ ♛ Steel)	6	18	9	,,
Steel Land Boiler Plates (Glasgow ♛ ♛ Steel)	6	7	6	,,
Steel Marine Boiler Plates (Glasgow ♛ ♛ Steel)	6	7	6	,,

Less 5 per cent. discount. Extras as per standard list.

Special prices for delivery in England and for export. The above prices subject to alteration without notice.

John Spencer (Coatbridge), Ltd., Phœnix Ironworks, Coatbridge, N.B., quotes :—

	£	s.	d.
Bars—Phœnix	6	5	0
,, Best	6	15	0
,, Best Best	7	5	0
,, Extra Best	7	15	0
,, Best Horse Shoe	6	15	0
,, Extra B.H.S.	7	15	0
,, Extra Best Cable	8	5	0
,, Rivet	6	5	0
,, Best Scrap Rivet	7	5	0

	£	s.	d.
Angles—Phœnix	6	5	0
„ Best	6	15	0
„ Extra Best	7	5	0
Gas Tube Hoops—Phœnix Best	6	15	0
Plates—Phœnix	—		
„ Best Boiler	7	10	0
„ Best Best Boiler	8	0	0
„ Extra Best Boiler	9	0	0
Boiler Tube Strips—Phœnix Best Best	8	0	0

All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly.

Messrs. R. Feldtmann and Co., of Glasgow, quote Commission extra).

Pig Iron:

	No. 1.			No. 3.		
	£	s.	d.	£	s.	d.
Coltness, f.a.s. Glasgow	3	5	0	2	15	0
Gartsherrie „	2	19	6	2	14	6
Summerlee „	3	0	6	2	15	0
Carnbroe „	2	17	6	2	14	0
Langloan „	3	4	0	2	16	0
Calder „	2	19	0	2	14	6
Clyde „	2	19	0	2	14	6
Glengarnock, f.o.b. Ardrossan	2	19	0	2	13	6
Eglinton „ „	2	15	6	2	13	0
Dalmellington, „ Ayr	2	15	6	2	13	0
Shotts „ Leith	2	19	0	2	14	6

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, **at works**:—

	£	s.	d.
W.W. ♛ Bars	6	12	6
W.W. Best Bars	7	2	6
W.W. Best Best	7	12	6
W.W. Best Best Best	8	2	6
W.W. Best Shoe	7	2	6
Thornaby ♛	8	2	6
Thornaby Best	8	12	6
Thornaby Best Best	9	12	6
Whitwell Special Admiralty Cable	10	5	0
Special Chain Iron	9	5	0
Tube and Nail Strips	6	15	0
W.W. ♛ Angle Iron	6	15	0
W.W. Best Angle Iron	7	5	0
Tee Iron, to 8-inches United	7	12	6

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington, quote:—

	Iron.			Steel.		
	£	s	d.	£	s.	d.
Crown (BNF) Bars	6	10	0	7	5	0
„ „ Angles	7	0	0	7	5	0
„ „ Tees	7	10	0	7	15	0
„ (WIW) Hoops	7	0	0	7	10	0
„ „ Sheets	7	10	0	8	0	0

Ordinary Sizes, F.A.S. Liverpool in 10-ton Lots.
Extras for Sizes and Cutting as per List.

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

Black Sheets:	Singles 20 G 96in. by 36in. per ton.			Doubles 21 G to 24 G 96in. by 36in. per ton.		
	£	s.	d.	£	s.	d.
"Vale"	10	0	0	10	10	0
"Shield"	10	10	0	11	10	0
"Severn"	11	10	0	12	10	0
"Baldwin Wilden B."	12	10	0	13	10	0
Charcoal	16	10	0	17	10	0
Best Charcoal	18	10	0	19	10	0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:						
	£	s.	d.	£	s.	d.
No. 3 Lead	13	10	0	14	10	0
S.V. Lead	15	0	0	16	0	0
No. 3 Terne	15	0	0	16	0	0
S.V. Terne	16	10	0	17	10	0

Tinned Sheets:	Singles 20 G to 108 by 36in. per ton.			Doubles 21 to 24 G to 96 by 36in. per ton.		
	£	s.	d.	£	s.	d.
Best Coke (Finish)	28	0	0	29	10	0
„ Charcoal (Finish)	30	0	0	31	10	0
Extra „ „	32	0	0	33	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.
Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box.
Extreme sizes in Tin and Patent Coated specially quoted for.
Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.
At works less 2½% for cash monthly, 10th inst.

Galvanized Corrugated Sheets:

	£	s.	d.	
"Phœnix" Brand, 24 G., f.o.b. London, in Bundles	11	15	0	per ton.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	14	7	6	„

Galvanized Working Up-Sheets:

	£	s.	d.	
24 G., f.o.b. London, in Bundles	13	15	0	per ton.

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£	s.	d.	
Crown Bars	6	10	0	per ton.
Best Bars (1 to 6in. wide, above ¼ in. thick, ½ in. to 4 rounds and squares)	7	0	0	„
Angles	6	15	0	„
„ Best	7	5	0	„
T's	7	0	0	„
„ Best	7	10	0	„
Best Shoe Iron	8	0	0	„
„ Rivet Iron	8	0	0	„
„ Best Rivet (Special)	9	5	0	„
„ Cable	9	5	0	„
„ Screwing	8	5	0	„

	£	s.	d.	
Best Turning	8	0	0	per ton.
,, Plating	8	5	0	,,
,, ,, Best Best	9	5	0	,,
,, ,, Treble	10	5	0	,,
Plates	7	10	0	,,
Best Plates	8	0	0	,,
,, Boiler Plates	8	10	0	,,
,, Best Boiler Plates	9	10	0	,,
Treble Best Boiler Plates	12	0	0	,,

Delivery f.o.b. Liverpool, Birkenhead or Manchester.

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon., quote "Star" brand patent wrought nails, steel nails, &c.

Discounts—

45 per cent. off 1-inch to 3-inch strong rose and all fine rose and 6dy. and 8dy. pound.

40 per cent. off 3½-inch to 7-inch strong rose and 10dy. and 20dy. pound.

40 per cent. off all sharp-pointed nails.

Delivered in lots of 4 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis :—
2 tons 9/6 per cwt.
4 cwt. lots and upwards 9/9 per cwt. } d/d any Railway Station.

Steel cut nails, 3-inch basis—
2 tons 8/3 per cwt.
4 cwt. lots 8/6 per cwt. } d/d any Railway Station.

Slit rods (iron) £7 10s. per ton, at works for 2-ton lots.

Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E. C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla, quote :—

	Per Box. f.o.b. Wales. £	s.	d.
Coke Tin-plates.			
C 18¾ by 14 124s. 110 lb. "BV"	0	13	0
C 20 by 10 225s. 155 ,, "Jumbo"	0	18	3
C 20 by 14 112s. 108 ,, "Lydbrook"	0	12	6
C 28 by 20 112s. 216 ,, "Lydbrook"	1	5	3
Charcoal Tinplates:			
C 20 by 14 112s. 108 lb. "Allaway"	0	13	3

BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes :—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

		£	s.	d	
Steel:					
Blooms	at	3	12	0	per ton.
Billets	at	3	14	0	,,
Sheet Bars	at	3	16	0	,,
Finished Steel:					
Bars	at	5	0	0	per ton.
Angles	at	5	1	0	,,
Tees	at	5	4	0	,,
Joists	at	4	10	0	,,
Fencing Standards	at	5	2	0	,,
Shoeing Bars	at	5	4	0	,,
Tyre Bars	at	5	4	0	,,
Half-Round Bars	at	5	5	0	,,
Heavy Rails	at	4	15	0	,,
Light Rails	at	4	17	6	,,

Structural Steelwork:

Prices on application.

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote :—

TIN.

Tin:	£	s.	d.		£	s.	d.	
English Ingots, f.o.b. Dis. 1½% & 1%	131	10	0	to	132	0	0	per ton.
English Bars, f.o.b. Dis. 1½% & 1%	132	10	0	to	133	0	0	,,
Straits G.M.B., cash Warehouse, Net	130	17	6	to	131	0	0	,,
Straits G.M.B., 3 months, Warehouse, Net	129	17	6	to	130	0	0	,,
Australian, Mr. Bischoff, Warehouse, Net	131	7	6	to	131	10	0	,,

COPPER.

Copper:	£	s.	d.		£	s.	d.	
Standard G.M.B., cash Warehouse, Net	67	6	3	to	67	7	6	per ton.
Standard G.M.B., 3 months, Warehouse, Net	67	11	3	to	67	12	6	,,
English, Tough, Cake & Ingot, Warehouses, Net	70	0	0	to	70	10	0	,,
English, Best Select, Warehouse Net	70	15	0	to	71	5	0	,,
English, Sheets and Sheathing, f.o.b., Dis. 2½%	80	0	0	to	80	10	0	,,
English, Sheets for India, f.o.b., Dis. 2½%	76	0	0	to	76	10	0	,,
Electro, Warehouse, Net	70	15	0	to	71	0	0	,,
Ore, ex. ship	0	12	0	to	0	13	0	per unit.
Regulus, Matte and Precipitate, ex. ship,	0	13	3	to	0	14	0	,,

YELLOW METAL.

Yellow Metal:	£	s.	d.	£	s.	d.	
Sheets, 4 by 4 feet for India f.o.b. Dis. 2½%				0	0	6¾	per lb.
Sheathing ,, ,,				0	0	6⅛	,,

SPELTER.

	£	s.	d.		£	s.	d.	
Silesian outports, Net	24	15	0	to	25	0	0	per ton.
Blende of 50% Net	6	16	6	to	7	0	0	,,
Calamine, Net	6	19	0	to	7	0	0	,,

LEAD.

	£	s.	d.		£	s.	d.	
English Pig, Warehouse, Dis. 2½%	12	17	6	to	13	0	0	per ton.
Spanish, ex ship, Dis. 2½%	12	12	6	to	12	15	0	,,
Lead Ore of 70%, Net	6	10	0	to	6	12	6	,,

ANTIMONY.

	£	s.	d.		£	s.	d.	
Star Regulus, f.o.b., Dis. 2½%	36	0	0	to	37	0	0	per ton.
Ore, 50%, ex ship, Dis. 2½%	8	0	0	to	9	0	0	,,
Crude, ex ship, Dis. 2½%	13	10	0	to	14	0	0	,,

QUICKSILVER.

	£	s.	d.	
Spanish, 75 lb., Warehouse, Net	7	12	6	per flask.
Italian ,, ,, ,,	7	11	6	,,

	£	s.	d.
Angles—Phœnix	6	5	0
,, Best	6	15	0
,, Extra Best	7	5	0
Gas Tube Hoops—Phœnix Best	6	15	0
Plates—Phœnix	—		
,, Best Boiler	7	10	0
,, Best Best Boiler	8	0	0
,, Extra Best Boiler	9	0	0
Boiler Tube Strips—Phœnix Best Best	8	0	0

All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly.

Messrs. R. Feldtmann and Co., of Glasgow, quote Commission extra).

Pig Iron:

	No. 1.			No. 3.		
	£	s.	d.	£	s.	d.
Coltness, f.a.s. Glasgow	3	5	0	2	15	0
Gartsherrie ,,	2	19	6	2	14	6
Summerlee ,,	3	0	6	2	15	0
Carnbroe ,,	2	17	6	2	14	0
Langloan ,,	3	4	0	2	16	0
Calder ,,	2	19	0	2	14	6
Clyde ,,	2	19	0	2	14	6
Glengarnock, f.o.b. Ardrossan	2	19	0	2	13	6
Eglinton ,, ,,	2	15	6	2	13	0
Dalmellington, ,, Ayr	2	15	6	2	13	0
Shotts ,, Leith	2	19	0	2	14	6

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, **at works:—**

	£	s.	d.
W.W. ♛ Bars	6	12	6
W.W. Best Bars	7	2	6
W.W. Best Best	7	12	6
W.W. Best Best Best	8	2	6
W.W. Best Shoe	7	2	6
Thornaby ♛	8	2	6
Thornaby Best	8	12	6
Thornaby Best Best	9	12	6
Whitwell Special Admiralty Cable	10	5	0
Special Chain Iron	9	5	0
Tube and Nail Strips	6	15	0
W.W. ♛ Angle Iron	6	15	0
W.W. Best Angle Iron	7	5	0
Tee Iron, to 8-inches United	7	12	6

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington, quote:—

	Iron.			Steel.		
	£	s	d.	£	s.	d.
Crown (BNF) Bars	6	10	0	7	5	0
,, ,, Angles	7	0	0	7	5	0
,, ,, Tees	7	10	0	7	15	0
,, (WIW) Hoops	7	0	0	7	10	0
,, ,, Sheets	7	10	0	8	0	0

Ordinary Sizes, F.A.S. Liverpool in 10-ton Lots.
Extras for Sizes and Cutting as per List.

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

Black Sheets:	Singles 20 G 96in. by 36in. per ton.			Doubles 21 G to 24 G 96in. by 36in. per ton.		
	£	s.	d.	£	s.	d.
"Vale"	10	0	0	10	10	0
"Shield"	10	10	0	11	10	0
"Severn"	11	10	0	12	10	0
"Baldwin Wilden B."	12	10	0	13	10	0
Charcoal	16	10	0	17	10	0
Best Charcoal	18	10	0	19	10	0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:	£	s.	d.	£	s.	d.
No. 3 Lead	13	10	0	14	10	0
S.V. Lead	15	0	0	16	0	0
No. 3 Terne	15	0	0	16	0	0
S.V. Terne	16	10	0	17	10	0

Tinned Sheets:	Singles 20 G to 108 by 36in. per ton.			Doubles 21 to 24 G to 96 by 36in. per ton.		
	£	s.	d.	£	s.	d.
Best Coke (Finish)	28	0	0	29	10	0
,, Charcoal (Finish)	30	0	0	31	10	0
Extra ,, ,,	32	0	0	33	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.

Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box.

Extreme sizes in Tin and Patent Coated specially quoted for.

Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.

At works less 2½% for cash monthly, 10th inst.

Galvanized Corrugated Sheets:

	£	s.	d.	
"Phœnix" Brand, 24 G., f.o.b. London, in Bundles	11	15	0	per ton.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	14	7	6	,,

Galvanized Working Up-Sheets:

	£	s.	d.	
24 G., f.o.b. London, in Bundles	13	15	0	per ton.

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£	s.	d.	
Crown Bars	6	10	0	per ton.
Best Bars (1 to 6in. wide, above ½ in. thick, ½ in. to 4 rounds and squares)	7	0	0	,,
Angles	6	15	0	,,
,, Best	7	5	0	,,
T's	7	0	0	,,
,, Best	7	10	0	,,
Best Shoe Iron	8	0	0	,,
,, Rivet Iron	8	0	0	,,
,, Best Rivet (Special)	9	5	0	,,
,, Cable	9	5	0	,,
,, Screwing	8	5	0	,,

	£	s.	d.	
Best Turning	8	0	0	per ton.
,, Plating	8	5	0	,,
,, ,, Best Best	9	5	0	,,
,, ,, Treble	10	5	0	,,
Plates	7	10	0	,,
Best Plates	8	0	0	,,
,, Boiler Plates	8	10	0	,,
,, Best Boiler Plates	9	10	0	,,
Treble Best Boiler Plates	12	0	0	,,

Delivery f.o.b. Liverpool, Birkenhead or Manchester.

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon., quote "Star" brand patent wrought nails, steel nails, &c.

Discounts—

45 per cent. off 1-inch to 3-inch strong rose and all fine rose and 6dy. and 8dy. pound.

40 per cent. off 3½-inch to 7-inch strong rose and 10dy. and 20dy. pound.

40 per cent. off all sharp-pointed nails.

Delivered in lots of 4 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis :—

2 tons 9/6 per cwt.
4 cwt. lots and upwards 9/9 per cwt. } d/d any Railway Station.

Steel cut nails, 3-inch basis—

2 tons 8/3 per cwt.
4 cwt. lots 8/6 per cwt. } d/d any Railway Station.

Slit rods (iron) £7 10s. per ton, at works for 2-ton lots.

Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E. C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla, quote :—

	Per Box. f.o.b. Wales. £	s.	d.
Coke Tin-plates.			
C 18¾ by 14 124s. 110 lb. "BV"	0	13	0
C 20 by 10 225s. 155 ,, "Jumbo"	0	18	3
C 20 by 14 112s. 108 ,, "Lydbrook"	0	12	6
C 28 by 20 112s. 216 ,, "Lydbrook"	1	5	3
Charcoal Tinplates :			
C 20 by 14 112s. 108 lb. "Allaway"	0	13	3

BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes :—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

		£	s.	d	
Steel:					
Blooms	at	3	12	0	per ton.
Billets	at	3	14	0	,,
Sheet Bars	at	3	16	0	,,
Finished Steel:					
Bars	at	5	0	0	per ton.
Angles	at	5	1	0	,,
Tees	at	5	4	0	,,
Joists	at	4	10	0	,,
Fencing Standards	at	5	2	0	,,
Shoeing Bars	at	5	4	0	,,
Tyre Bars	at	5	4	0	,,
Half-Round Bars	at	5	5	0	,,
Heavy Rails	at	4	15	0	,,
Light Rails	at	4	17	6	,,

Structural Steelwork:

Prices on application.

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote :—

TIN.

Tin:	£	s.	d.		£	s.	d.	
English Ingots, f.o.b. Dis. 1½% & 1%	131	10	0	to	132	0	0	per ton.
English Bars, f.o.b. Dis. 1½% & 1%	132	10	0	to	133	0	0	,,
Straits G.M.B., cash Warehouse, Net	130	17	6	to	131	0	0	,,
Straits G.M.B., 3 months, Warehouse, Net	129	17	6	to	130	0	0	,,
Australian, Mr. Bischoff, Warehouse, Net	131	7	6	to	131	10	0	,,

COPPER.

Copper:	£	s.	d.		£	s.	d.	
Standard G.M.B., cash Warehouse, Net	67	6	3	to	67	7	6	per ton.
Standard G.M.B., 3 months, Warehouse, Net	67	11	3	to	67	12	6	,,
English, Tough, Cake & Ingot, Warehouses, Net	70	0	0	to	70	10	0	,,
English, Best Select, Warehouse Net	70	15	0	to	71	5	0	,,
English, Sheets and Sheathing, f.o.b., Dis. 2½%	80	0	0	to	80	10	0	,,
English, Sheets for India, f.o.b., Dis. 2½%	76	0	0	to	76	10	0	,,
Electro, Warehouse, Net	70	15	0	to	71	0	0	,,
Ore, ex. ship	0	12	0	to	0	13	0	per unit.
Regulus, Matte and Precipitate, ex. ship,	0	13	3	to	0	14	0	,,

YELLOW METAL.

Yellow Metal:	£	s.	d.	
Sheets, 4 by 4 feet for India f.o.b. Dis. 2½%	0	0	6¾	per lb.
Sheathing ,, ,,	0	0	6⅝	,,

SPELTER.

	£	s.	d.		£	s.	d.	
Silesian outports, Net	24	15	0	to	25	0	0	per ton.
Blende of 50 % Net	6	16	6	to	7	0	0	,,
Calamine, Net	6	19	0	to	7	0	0	,,

LEAD.

	£	s.	d.		£	s.	d.	
English Pig, Warehouse, Dis. 2½%	12	17	6	to	13	0	0	per ton.
Spanish, ex ship, Dis. 2½%	12	12	6	to	12	15	0	,,
Lead Ore of 70 %, Net	6	10	0	to	6	12	6	,,

ANTIMONY.

	£	s.	d.		£	s.	d.	
Star Regulus, f.o.b., Dis. 2½ %	36	0	0	to	37	0	0	per ton.
Ore, 50 %, ex ship, Dis. 2½%	8	0	0	to	9	0	0	,,
Crude, ex ship, Dis. 2½ %	13	10	0	to	14	0	0	,,

QUICKSILVER.

	£	s.	d.	
Spanish, 75 lb., Warehouse, Net	7	12	6	per flask.
Italian ,, ,, ,,	7	11	6	,,

COAL.

LEICESTERSHIRE.

The Nailstone Colliery Company, Leicester, quote. Price per Ton at Pit of 20 Cwt., with ½ Cwt. per Ton for wastage —

Upper Main Seam.	s.	d.
Main Coal	7	6
Best Hard Steam (hand picked, as used by the Railway Companies)	6	0
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)	6	0
Fine Slack	0	6

Terms, net cash on 10th of month following delivery.

DERBYSHIRE.

The Manners Colliery Co., Ltd., of Ilkeston quote as follows, per ton at pit:

Kilburn Coal:	s.	d.
Best London Brights	9	9
Large Nuts (1½ to 3½)	9	6
Small Nuts (¾ to 1½)	6	0
Rough Brights	6	0
Peas (⅜ to ¾)	5	0
Slack	3	6
Smudge	2	0

Low Main (or Tupton) Coal:	s.	d.
Low Main Brights	7	6
,, ,, Nuts	7	3
Hards (Good Steam Coal)	8	0
Bakers' Nuts (1" to 2")	6	6
Slack	3	6

The Clay Cross Company's Collieries, Clay Cross, near Chesterfield, quote:—

	per ton at pit. s.	d.
Best Main Coal	10	6
Best Silkstone	10	0
Best House Coal	8	6
Best House Nuts	8	0
Treble Screened Cobbles	7	9
Best Cobbles	7	3

NOTTINGHAMSHIRE.

The Digby Colliery Co., Ltd., near Nottingham, quote per ton at pit:—

Digby Coal:

STEAM.	s.	d.
Best Hand Picked Hard	9	0
Steam Hard	7	9
Hard Nuts	7	0

Gedling Colliery.

HIGH HAZEL.		
London Brights, 4 to 8 in. cube	12	0
Large Nuts, 2 to 4 in. cube	9	6
Small Nuts, ½ to 2 in. cube	5	6

STEAM.—TOP HARD.		
Best Hard	9	0
Hard Steam	8	0
Cobbles	7	0

CHEMICALS AND OILS.

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square, Manchester, quote:

	£	s.	d.	
Acids: Oxalic	0	0	2¼	per lb.
Picric, Crystals	0	0	11	,,
Tartaric ... at Manchester	0	0	10⅞	,,

	£	s.	d.	
Acetate of Lime: Brown at Manchester net	9	10	0	per ton.
Grey ,,	11	10	0	,,
Alumina: Alum, Lump, loose	5	5	0	,,
,, ,, in casks	5	7	6	,,
,, Ground, in bags	5	15	0	,,
Sulphate of Alumina, 14%	4	10	0	,,
Ammonia: Carbonate	0	0	3⅝	per lb.
Muriate Grey f.o.b. Liverpool	24	0	0	per ton.
Sal-ammoniac, Lump, 1sts, del^d. U.K.	42	0	0	,,
,, ,, 2nds, ,,	40	0	0	,,
Sulphate ... f.o.b. Liverpool	13	2	6	,,
Arsenic: Best White Powdered ... net	12	5	0	,,
Bleaching Powder, 35% ... ,,	4	10	0	,,
Borax: British Refined Crystal ... ,,	12	0	0	,,

Coal Tar Products:	£	s.	d.	
Benzole, 50/90 % ... ,,	0	0	8¼	per gal.
,, 90% ... ,,	0	0	10	,,
Carbolic Acid Crystals, 34/35° C. ... ,,	0	0	6⅞	per lb.
,, ,, ,, 39/40° C. ... ,,	0	0	7⅛	,,
,, ,, Liquid, 97/99 % ... ,,	0	0	9	per gal.
,, ,, Crude, 62½% at 60° F. f.o.b. ,,	0	2	0	,,
Creosote, ordinary good liquid ... ,,	0	0	1¼	,,
Naphtha, Crude, 20 % at 120° C. ... ,,	0	0	3	,,
,, Solvent, 90% at 160° C. f.o.b ,,	0	0	8½	,,
,, ,, 95 % at 160° C. ,, ,,	0	0	9½	,,
,, ,, 90 % at 190° C. ,, ,,	0	0	10½	,,
,, Rectified, flash point over 73° F. ... f.o.b. ,,	0	0	11	,,
,, Rectified, flash point over 100° F. ... f.o.b. ,,		1	0	,,
Naphthalene, all qualities.				
Pitch ... f.a.s. Manchester. ,,	1	12	0	per ton.
Copperas: Green, in bulk ... ,,	0	12	6	,,
,, barrels f.o.b. L'pool ,,	1	19	0	,,
Cake ... ,,	1	2	6	,,
Copper: Sulphate	22	5	0	,,
Cyanides: 98% minimum ... f.o.b. net	0	0	8	per lb.
Lead: Acetate (Sugar) White, English	27	10	0	per ton.
,, ,, ,, Foreign c.i.f. U.K	24	5	0	,,
,, ,, Grey	21	15	0	,,
,, ,, Brown at Manchester	17	0	0	,,
Nitrate	24	0	0	,,
Litharge, Flake	15	10	0	,,
,, Powder	16	0	0	,,
Red Lead, Genuine, c.i.f. London less 5%	15	10	0	,,
White ,, ,, Dry ,, ,, ,,	16	15	0	,,
Naphtha (Wood): Miscible, 60 o.p.	0	2	10	per gal.
Solvent	0	2	7	,,
Potash: Bichromate... delivered England...	0	0	3	per lb.
Carbonate, 90/92 % ... c.i.f Hull ...	18	0	0	per ton.
Caustic, 75/80 % ... ,, ,, ...	20	10	0	,,
Chlorate ... net	0	0	3½	per lb.
Montreal ... in Store, Liverpool	35	0	0	per ton.
Prussiate, Yellow ... net	0	0	4 1/16	per lb

1723. F. Lobnitz, Glasgow. Jan. 28th. — Improvements connected with apparatus for breaking up or cutting rocks, stones or earth under water, or on dry land.

1728. J. Cleland and J. C. Stewart, Belfast. Jan. 28th'—Valves for steam or other fluid pressures.

1734. M. F. M. Mulready, and E. M. Mulready, London. Jan. 28th—Improvements in gas engines and the like.

RECENT SPECIFICATIONS.

STEAM TURBINES.

Willans and Robinson, Ltd., and M. H. P. Sankey, of Rugby. March 11th, 1904.—Refers to fixing the blades of a turbine. According to this invention, the blades are not fixed to the segment, but are held between the side of the groove and the side of the segment by the pressure caused by the caulking ring. For this purpose the ends of the blades are stamped or otherwise formed to a right-angled, or approximately right-angled section or tang, one side of the right angle entering a slot in the segment, whilst the other lies flat against the side of the segment. The grooves and segments are preferably both of a dovetailed form, as has before been proposed, and according to this invention, that side of the right-angled tang which lies between the side of the segment and the side of the groove, is also preferably dovetailed, the metal being thickest at the extreme end of the blade. The slots in the segments and the other side of the right-angled-shaped tang may also be dovetailed, the latter being broadest at their extreme ends. The sides of the grooves may be circumferentially corrugated to give a better hold on the blades. One side of the right angled tang may be longer than the other, the other being cut off in the stamping process, and the longer part may be bent up at right angle, so as to lie upon the underside of the ring, and so make the dovetailing effect more pronounced.

Fig. 1

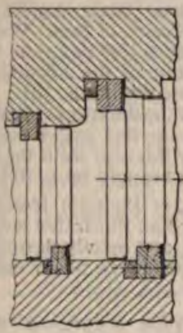


Fig. 5

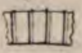


Fig. 4

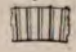


Fig. 2

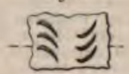
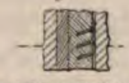


Fig. 3



STEAM GENERATORS.

Glover's Water Tube Boiler Company, Ltd., and D. Crowther, of Leeds. March 1st, 1904. — This invention relates to an improvement in the means for attaching the ends of water tubes to other parts of steam generators, and more particularly to such, in which a junction box, casing or header, as it is variously called, is used for making the connection. The invention is described with reference to its application to secure the ends of water tubes, situated within the flue tube of a boiler, the end portion of the water tube being supposed to run longitudinally or parallel with the flue plate. A junction box is employed, having the end face, into which the end of the water tube is inserted at right angles to the flue plate, and the side having the opening for communicating with the interior of the boiler, machined to the curve of the flue plate. This latter side of the junction box is formed at both ends with a flange extending longitudinally. The object of this is, to obtain a greater base or leverage to resist any strains thrown on the joint. A boss is formed on the inner side of this joint face, round the opening in it; and the opening is tapped to receive a short piece of piping, which serves as a bolt to secure the joint. A washer or plate is fitted against the inner or water side of the flue plate, and made of a length and breadth equal to or somewhat greater than the length and breadth of the joint face of the junction box, and curved in the shorter direction to fit the curve of the flue plate, and is provided with a central opening to fit over the aforesaid pipe, while a nut on the end of said pipe draws the connection tight. Owing to the greater longitudinal extension of the joint face of the junction box, and of the internal washer and the comparatively large diameter of the screwed or bolt pipe, this connection is much less likely to become leaky, than is the case where a single central bolt is used to secure the connection.

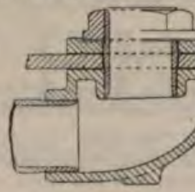


FIG 1.

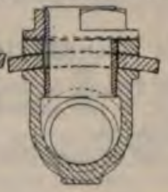


FIG. 2.

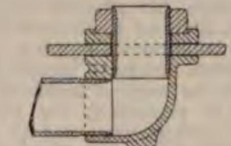


FIG. 3.

FIG. 4

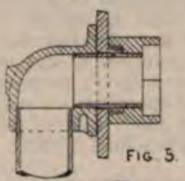


FIG. 5.

FIG. 6.

ROTARY ENGINES.

H. E. Parry, R. W. Thomson and W. J. Farley, of Perth, Western Australia. July 13th, 1904.—This invention of an improved reversible rotary engine consists in the employment of a rotary and circular piston working within an eleptical-shaped cylinder, and also in the peculiar arrangement of the central circular valve which proceeds into the bore of the piston and communicating with ports formed radially in the piston for the admission and exit of steam to and from each of the driving blades of the piston. It essentially consists in the means for independently or concurrently operating the valves and also in means for controlling the elliptical travel of the multiple blades, and for the simultaneous admission and exit of steam to and from opposite points of the piston, so allowing of an easy and instant reversal of the engine, and also of the use of the steam to its maximum expansive value.

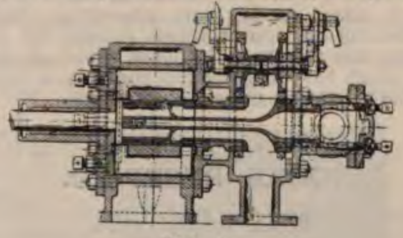


FIG. 1.

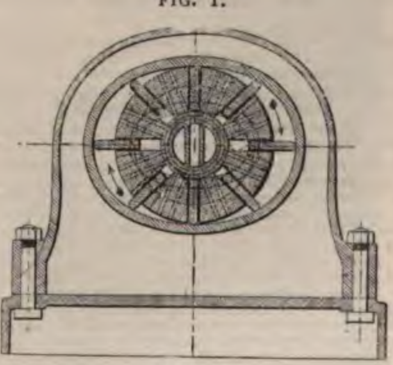


FIG. 2.

NEW PUBLICATIONS.

"GETTING GOLD."

A Practical Treatise for Prospectors, Miners, and Students. By J. C. F. Johnson, F.G.S. Charles Griffin and Co., Ltd. 3s. 6d.

It is quite obvious that this work is the outcome of many years' practical experience, and the need of such a book is emphasised by the rapid development of the gold-mining industry. After an informing introduction the writer addresses his remarks mainly to inexperienced prospectors, advising them upon a course of studies preparatory to their embarking on a "getting gold" expedition. He then discusses prospecting as conducted on alluvial fields, the origin of auriferous lodes, the mode by which in all probability the gold was conveyed to them and deposited as metal, and the derivation of gold in auriferous drifts. In the section devoted to Gold Extraction, the treatment of ores and matrixes for the extraction of the metal contained is dealt with. The following chapters are devoted to secondary processes and lixiviation, calcination of ores, motor power and its transmission. The author's pertinent remarks on company formation and operation are suggestive and to the point, but we think his "Rules of Thumb" will be more appreciated by his practical readers.

"THE PRACTICAL ELECTRICIAN'S POCKET BOOK, 1905."

Edited by H. T. Crewe, M.I.Mech.E. S. Rentell and Co., Ltd. 1s.

This handy and most useful little compilation has now reached its eighth year of publication; the present issue has been thoroughly revised and enlarged, and in view of the increasing interest in alternating currents, a section has been added dealing with alternators. Additional matter bearing on steam turbines, patents, and wireless telegraphy has also been included, while all the old features which have rendered this pocket book indispensable to the practical man have been retained.

BOOKS RECEIVED.

Valves and Valve-Gearing. A Practical Text-Book for the Use of Engineers, Draughtsmen and Students. By Charles Hurst. Fourth Edition. With numereus illustrations. Charles Griffin and Co., Ltd 10s. 6d.

The Universal Electrical Directory (J. A. Berly's). Containing a complete Record of all the industries directly or indirectly concerned with Electricity and Magnetism. Alabaster, Gatehouse and Co. 10s.

A class-book of Naval Architecture; Practical, laying-off, Theoretical. By W. J. Lovett. Illustrated. Longmans, Green and Co. 7s. 6d.

Transactions of the North-East Coast Institution of Engineers and Shipbuilders. Vol. xxi. Parts 1 and 2. Andrew Reid and Co., Ltd.

We have also received: "Laboratory Notes on Practical Metallurgy," by Walter MacFarlane, F.I.C. (Longman's Green and Co., 2s. 6d.) A graduated series of exercises clearly demonstrating metallurgical principles; eminently suitable for technical school students. "The Commission of H.M.S. *Fox*, East Indies Station, 1901-1904," by F. E. Nobbs and W. T. Berger (The Westminster Press, 4s.) We have previously called attention to this excellent "Log" series, the high standard of interest of former volumes is well maintained by the story of the *Fox*. "Astronomy without a Telescope," by E. Walter Maunders, F.R.A.S., illustrated by star maps and key diagrams (W. Thacker and Co.), a guide to the study of the constellations with the unassisted sight, written in a popular style, and calculated to awaken a more general interest in astronomy. "The Construction of Cranes and other Lifting Machinery," by Edward C. R. Marks, M.I. Mech.E., third edition (Technical Publishing Co., Ltd., 3s. 6d. net). Part I. discusses the general principles and practice in standard types of lifting machines; Part II. some patented inventions relative to lifting machinery; Part III., examples of present practice by leading makers of lifting machinery, illustrating the extensive and extending application of electrical energy to the operation of Cranes, etc.; the illustrations are a strong feature of the work, which should be studied by every mechanical engineer.

NEW CATALOGUES.

In issuing their various pamphlets, The Fairbanks Company, of 78-80, City Road, E.C., adopt a practice which might with advantage be followed by other manufacturers of machinery. Their various pamphlets are of a uniform octavo size and are bound in an adjustable expansive cover which makes the pamphlets handy for reference and preserves them from dust. Pamphlets received from this firm deal with weighing machines, cement testing, arcade files, reed-pipe fitters' tools, new process hot forged twist drills, emery and corundum wheels, the Moran flexible joint, double-tube injectors, Yale and Towne chain blocks, power transmission appliances, the "Fairbanks" improved gas and oil engines, skinner chucks, and pipe-threading and cutting machinery.

A third edition of their interesting little brochure, "Notes on Electric Lifts," has been issued by Messrs. Archibald Smith and Stevens, of Janus Works, Queen's Road, Battersea. The first few pages of the work are devoted to an enumeration of the advantages and disadvantages of electric and hydraulic lifts. The nature of current available and the different systems of control are then discussed, and the last pages contain extracts from letters received by the firm from their customers. All the tables have been brought up to date.

Messrs. G. F. Smith, Ltd., of Paragon Ironworks, South Parade, Halifax, forward an illustrated and descriptive catalogue of improved and newly-designed machine tools for engineers, shipbuilders, boiler makers, etc.

MEETINGS FOR THE ENSUING WEEK.

FRIDAY, FEB. 10.—Physical Society: Annual General Meeting. Royal College of Science, Exhibition Road, South Kensington, 8 p.m.: Address by Professor J. H. Poynting, F.R.S., on "Radiation Pressure."—Royal Society, Albemarle Street, W., 9 p.m.—Royal Astronomical Society, Burlington House, W.: Anniversary Meeting, 5 p.m.—Tramways and Light Railways Association.—Annual Meeting Society of Arts 8 p.m.—Institution of Civil Engineers, Students' Meeting, Great George Street, S.W. 8 p.m.: Paper, "The Reconstruction of the Santa Lucia River Bridge, Uruguay, by Mr. P. J. Risdon.—Institution of Mechanical Engineers: Students Banquet, Empire Rooms, Trocadero Restaurant.

SATURDAY, FEB. 11.—North of England Institute of Mining and Mechanical Engineers, Newcastle. 2 p.m.—Manchester Association of Engineers: Annual Dinner, Grand Hotel, Manchester.—Junior Institution of Engineers: Coming of Age Dinner, Hotel Cecil, Strand, 7 p.m.

MONDAY, FEB. 13—Society of Arts Cantor Lecture, 8 p.m.: "Internal Combustion Engines," Mr. Dugald Clerk, M.Inst.C.E., London Institution, 5 p.m.: Professor W. E. Ayrton, F.R.S., on "Energy: American, British and Japanese."—Institute of Marine Engineers, Stratford, 8 p.m.—Junior Institution of Engineers: Visit to Brockie Pell Arc Lamp Works, 6.30 p.m.

TUESDAY, FEB. 14.—Royal Institution, 5 p.m.: Paper, "Structure and Life of Animals," Professor Miall.—Manchester Steam User's Association: Jubilee Banquet, Midland Hotel, Manchester, 7.30 p.m.—University of Liverpool Engineering Society: Paper, "Present Day Iron and Steel Works," Mr. F. J. Brislee, M.Sc.—Institution of Electrical Engineers, Glasgow Local Section, 8 p.m.: Paper, "Earthing," Mr. W. W. Lackie.—Manchester Local Section, 8 p.m.: Paper, "Tramways Power Supply,' by Messrs. Pearce and Gunton.

WEDNESDAY, FEB. 15.—Institution of Civil Engineers: Dinner by Sir Guilford Molesworth, President, to the Council and honorary members, 8 p.m.—Society of Arts: Ordinary Meeting, 8 p.m.—Institution of Electrical Engineers (Birmingham Local Section), 8 p.m.—Chemical Society.

THURSDAY, FEB. 16.—Royal Society, 4.30 p.m.—Royal Institution 5 p.m.: Paper, "Recent Work of the Geological Society," Mr. J. H. Teall.—Society of Arts, 4.30 p.m.: Paper, "Indian Census of 1901," Sir C. A. Elliott.—Institution of Electrical Engineers (Leeds Local Section), 8 p.m.

FRIDAY, FEB. 17.—Geological Society: Anniversary Meeting, 8 p.m.—Chamber of Shipping: Meeting, Cannon Street Hotel, 11; Dinner, Hotel Metropole, 7 p.m.—Royal Institution, 9 p.m.: Paper, "High-Power Microscopy," Mr. J. W. Gordon.—North-East Coast Institution of Engineers and shipbuilders, Newcastle.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

VOL. VI. LONDON, FRIDAY, FEBRUARY 17, 1905. No. 23.

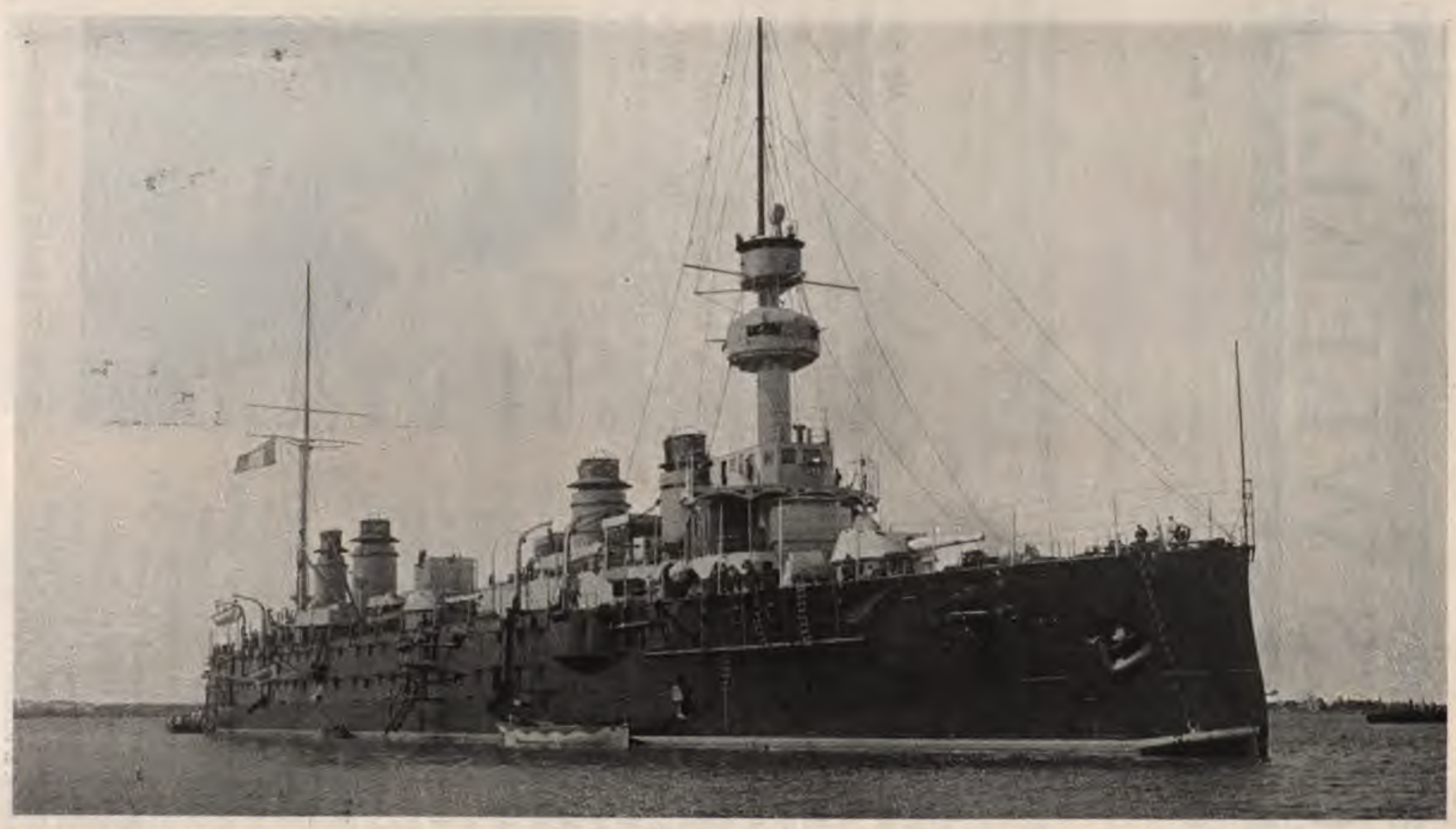
The Offices of "Page's Weekly," Wednesday, Midnight.

WE shall await with considerable interest the "proposals for improving the status of the Local Government Board and the Board of Trade and for establishing a Ministry of Commerce and Industry" as foreshadowed in the speech from the throne on Tuesday. We cannot agree with Earl Spencer that the proposed measure is a "very curious one" in view of the mischief which has been done in the past by hampering trade legislation, and the question of the noble earl "Is the Board of Trade to be *entirely suppressed* or converted into a new department?" seems a little superfluous in view of the expression "improving the status" of the bodies in question. The proposal is one which it is to be hoped will not be shelved. The appointment of a Minister of Commerce should be one of historic importance to the British Empire.

In the United States the President of Commerce and Labour is expected to foster and promote the foreign and domestic commerce of America, and call upon Consular representatives abroad to furnish reports on markets for American products. The French Ministry of Commerce and Industry performs similar service for France in pushing French commercial interests abroad. Austria, too, finds it worth while to appoint a Minister of Commerce. It is surely quite time that something is done to bring about a closer relationship between the commercial community and our own Government.

Mr. Lewis Nixon, President of the United States Shipbuilding Trust, has been asking himself and the readers of a magazine published in New York, whether gas producers are to mark the end of the steam age. He appears to think that but for what he calls the "conservatism of the engineering world" in the pursuit of steam developments, to the comparative neglect of the gas engine, we might by this time have arrived at a satisfactory

A RECENT PORTRAIT OF MR. MARCONI.
Whose forthcoming marriage is dealt with on page 376.



By courtesy of the Royal United Service Institution.]

THE NEW FRENCH FIRST-CLASS ARMOURED CRUISER "CONDE"; 10,000 TONS; 20,500-I.H.P.; SPEED, 21 KNOTS.

Armour Protection.—Water-line belt of 6-in. H.N.S., 6 ft. 6 in. deep, ending short way from stern in a 3·4-in. transverse bulkhead; an upper belt 5·5 in., reaching to main deck, tapering to 3·5 in. on bow, and 3-in. on stern; turrets, 5-in. with 2-in ammunition hoists; casemates and secondary turrets, 5-in.; conning tower, 8-in; protective deck, 1·7-in.; splinter deck, 1·4-in.

Armament.—Two 7·6-in. quick-firers in turrets, one forward and one aft; four 6·4-in. quick-firers in casements and four in turrets on upper deck; six 3·9-in. with shields; eighteen 3-pounder and six 1-pounder guns, with five torpedo-tubes, two submerged two armoured above water and one unarmoured at stern.

flying machine. Mr. Nixon cuts into a theme dear to the heart of Mr. B. H. Thwaite, when he says: "Can we predict the trend of development? I think the great strides made lately in the use of producer gas, and the distribution of coal through the ports of the world, will result in the use of producer gas plants on board vessels of larger size with engines using gas made by such plants." The producers, he continues, can be erected in less space than boilers, and it is already known that the gas engine can be produced of any size. We can proceed along lines already proved, and cut our coal bill in half. The greatest problem before the ship designer is how to handle the boiler. The production of power by steam engine gets us back at once to the man-fired boiler. We must have air and space in which to shovel, fire rooms whose size will prevent prostration from heat, and bunkers much larger than should be necessary, on account of the waste of coal. When we get our boiler space arranged, after obtaining every concession that can be squeezed out of all other factors, we proceed to build a vessel around it.

Mr. Nixon is enthusiastic about the proposed use of gasoline engines in war vessels. He says, for instance, that in torpedo-boats there is a decided advantage in the use of petroleum or gasoline. In a torpedo-boat developing 3,200 h.p. under forced draft, we would most certainly burn not less than three pounds of coal per i.h.p. per hour, or say for ten hours we would use at the least calculation ninety-six thousand pounds. We can develop a b.h.p. on a gallon of gasoline for ten hours, or we would use 3,200 gallons of fuel in the ten hours. In other words, we can increase the radius of action of such a vessel more than three times on the same weight of fuel. This assumes that a steam torpedo-boat can be run at full speed for ten hours under trial conditions. To get ready to force the steam-driven boat, we must take at least two hours coddling the boilers; during the run we must clean them, with consequent loss of speed and waste of fuel; while the strain upon the men of a constant full-pressure run of ten hours would be practically unbearable. The gasoline engines require no long working up of steam pressure, but are ready to start at full speed in an instant. There is no strain upon the men in the engine room. Mr. Nixon further says it is perfectly feasible under present conditions to produce a ten-thousand-ton cruiser of twenty-one knots that could steam around the world at fourteen knots without taking on fuel and without sacrificing anything in war efficiency or fighting power.

The electric street lamp-posts designed specially for the City of Sydney must be something quite unique in their way, for in describing his first impressions of them, a member of the Electrical Association of New South Wales said they reminded him of "something between a giraffe and an ostrich. It seemed to him that if the design had to be zoological, the authorities should not have overlooked the kangaroo." This, of course, was so much banter. The erection of lamps for the City of Sydney involved quite exceptional difficulties, chiefly occasioned by its awnings and its telegraph wires. The former render side lighting difficult on account of the heavy shadows on the footways. The overhead tramwire and the narrowness of the street prohibit centre lighting almost entirely. In every street there are overhead telephone wires, and in many streets these are on both sides of the road. They are usually at a height of 18 ft. 6 in. above the footway. These conditions led to the adoption of a special post, having a very large overhang and placed on the kerb.

With the lighting plant generally, much satisfaction appears to be felt. The following, among other details, were given at a meeting of the above Association by Mr. T. Rooke. The system decided upon was the generation of three-phase alternating current by steam power, and the transmission of the current at 5,000 volts to sub-stations, the conversion at two sub-stations to continuous currents for distribution on a three wire direct-current network, at 240 and 480 volts in the centre of the city, and the conversion at the other sub-stations by static transformers, for distribution on a four wire three-phase alternating current network at 240 and 415 volts, in the outlying portions of the city. Before adopting this system there were of necessity, many circumstances to take into account, and the advantages and disadvantages of many different methods of doing the same thing had to be considered. For public lighting it was decided to connect arc lamps in series across the distributors, ten open direct current lamps being provided on the 480 volts, and nine on the 415 volts alternating current.

The five boilers in the power house are of Messrs. Babcock and Wilcox well-known make, and constructed for a working pressure of 160 lb. per square inch. Each has a grate area of 58 square feet, and a heating surface of 3,240 square feet. The feed water pumps, says Mr. Rooke, are steam driven, although electrically driven feed pumps have become so fashionable of late. All other auxiliary machinery is electrically-driven, the absence of small steam mains, the quiet working, greater simplicity and the low maintenance cost being held to compensate for greater first cost.

The engines are of the vertical cross compound quick speed Ferranti type, which is chiefly remarkable for its valve gear. This is operated by cams contained in a box placed between the high-pressure and low-pressure cylinders, the whole of the gear being immersed in oil. The cams are operated from the crank shaft by bevel and helical gear; they are of uniform diameter and are therefore positive in their action, without resorting to springs. Variable cut-off is obtained by operating the valve rod from the centre of a yokepiece, connecting the bridles on two cams. One of these cams, that which admits steam, is fixed, the other cam, which cuts off steam, is movable, being fixed on a sleeve thread having a quick thread cut on its surface. The valves are placed in the cylinder heads, two steam and two exhaust valves being provided in each cylinder. The surface speed of the valve at 214 revolutions per minute, which is the speed of the 1,000 h.p. engine, is 22 ft. per minute. The electrical portion of the machinery consists of Dick Kerr three-phase generators producing current at an E.M.F. of 5,000 to 5,200 volts

REAR VIEW OF SHIELD USED FOR EXCAVATING THE UPPER HALF OF THE NEWLY-COMPLETED EAST BOSTON TUNNEL. (*See page* 376.)

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

DAVIDGE PAGE, Editor.

Clun House, Surrey Street, Strand, London, W.C.
Telephone No: 3349 GERRARD.
Telegraphic and Cable Address: "SINEWY, LONDON."

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New Copy for Advertisements,

Alterations, &c., intended for insertion in the current week's issue must be delivered **not later than 4 p.m. on Monday.** If proofs are required the copy and blocks should reach us several days earlier.

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NEWS ITEMS.

The Royal School of Mines.

Mr. T. Arthur Richard, presiding at the 32nd annual dinner of the old students of the Royal School of Mines, claimed that mining has done for our modern world what Raleigh and Frobisher, Drake and Hawkins did in the stirring times of Queen Elizabeth. It has given the materials for modern civilisation, it has been the pioneer of territorial expansion, and has found new worlds to redress the balance of the old. In the course of subsequent remarks, he said that the day for drifting and blundering had gone, the logical method of science was being applied to the direction of human affairs; and if they confessed with shame the better assistance given to the preparation of those who directed the business and technology of mining in countries other than our own, if they recognised the disregard for the well-being of an industry to which this nation owed so much, and if they saw that mines and melters owned by Englishmen were officered by their American and German friends, they were not to be jealous save in honourable rivalry, but say, as forcibly as they could, that it was high time for England to give her mining sons the preparation which she gave to her sailors and soldiers—in other words, there was need of a National School of Mines. The following memorial was signed at the dinner, and subsequently forwarded to the secretary of the Departmental Commission inquiring into the organisation of the Royal School of Mines: "Sir,—We, the undersigned associates and old students of the Royal School of Mines, all of whom have had practical experience in connection with mining and metallurgical industries, beg you to convey to the members of your committee our conviction that the following conditions are essential to the future efficiency of the school: (1) That the title be retained as 'The Royal School of Mines'; (2) that the diploma of 'Associate of the Royal School of Mines' be retained as heretofore; (3) that the School, even though it may be affiliated to some central institution, be preserved as a separate entity, as regards mining and metallurgical training, with its own special staff and organisation. We believe that these are the opinions of every associate and old student of the Royal School of Mines, and we beg to ask your committee to give its very serious consideration to the above points."

The exports of the Transvaal for the year 1904 amounted in value to £17,770,988, as compared with £12,969,912 for 1903.

THE JUNIOR INSTITUTION OF ENGINEERS.

COMING OF AGE DINNER.

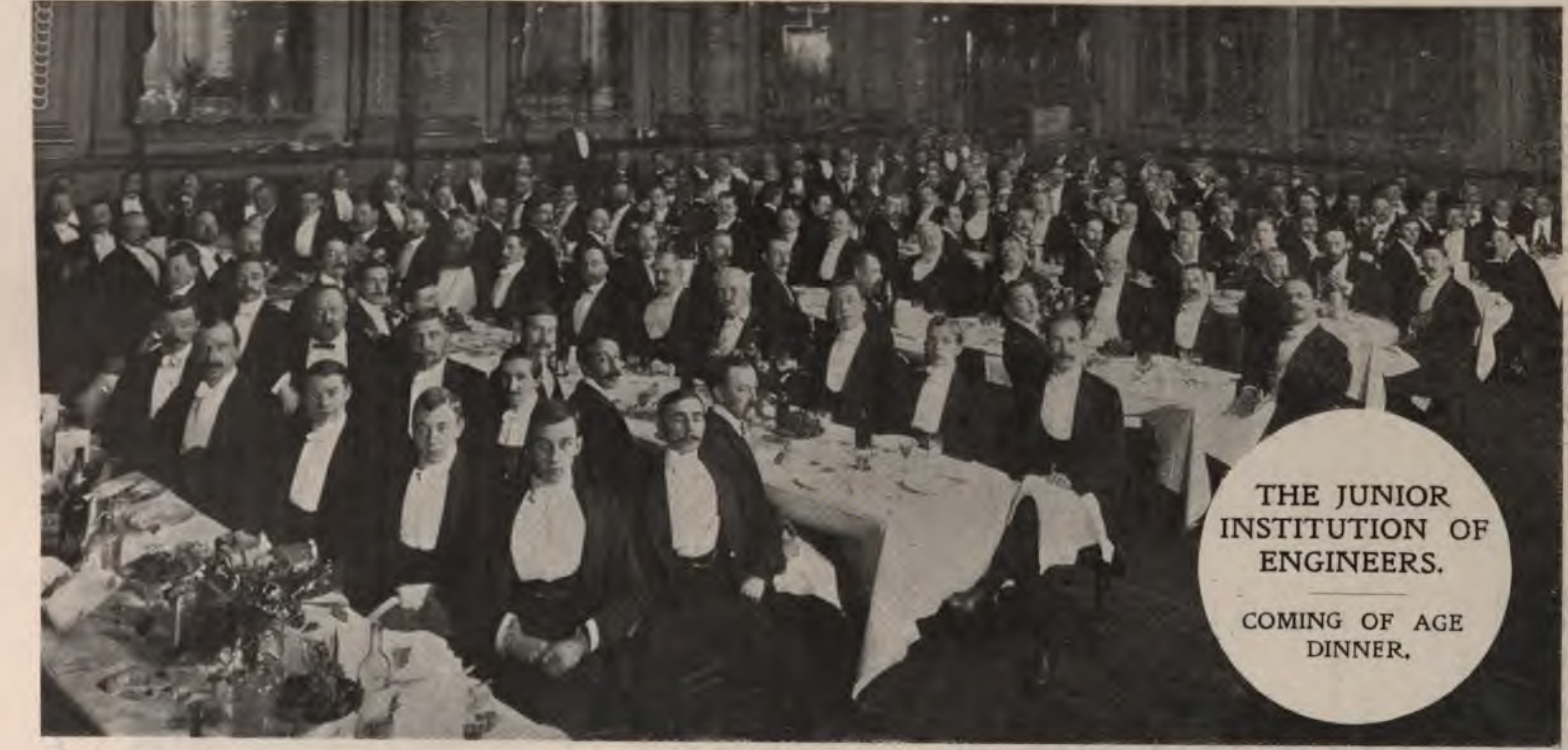


Photo by Fradelle and Young.]

MR. W. H. LINDLEY, M.INST.C.E., F.G.S. (PRESIDENT) IN THE CHAIR.

At the head table (A), reading from left to right, will be seen: Mr. H. J. Young, Mr. F. C. Cousins, Mr. J. B. Batchelor, Mr. S. H. Wells, Mr. C. de G. Sells, Professor H. E. Armstrong, Mr. J. P. Waldram, Mr. A. Siemens, Professor J. A. Ewing, Mr. J. H. Balfour Browne, Lord Reay, Mr. W. H. Lindley (President), Venerable Archdeacon W. M. Sinclair, Mr. James Swinburne, Dr. R. T. Glazebrook, Professor W. E. Ayrton, Mr. C Hawksley, Mr. D. Irving, Mr. S. Cutler, Mr. T. E. Gatehouse, Mr. W. Ballantyne, Mr. Harold Wade, Mr. W. J. Tennant, Mr. A. Ross, Mr. B. E. Dunbar Kilburn, W. T. Dunn, (Secretary), Col. H. R. Mead, Mr. J. W. Wilson.

At the other tables, reading from left to right of photo., are the following :—

Table (B): Messrs. H. N. Gray, R. H. Kenyon, F. Fraser, N. I. Ennor, E. Ketchell and G. Peyrecave.

Table (C): Messrs. E. A. Pettit, M. Isaacs, E. F. Corr, C. W. Pettit, J. A. Gardiner, J. W. Hunter, M. Rampal, F. C. Walker, W. P. Turner, A. Beck, E. Dickinson, J. Blackburn, J. W. Nisbet, F. H. Avent, A. Hoyle, J. Green, T. R. Jordan, J. Bailey, R. N. Tough, J. Shidinglaw, E. Scears, E. Grimwood and H. T. Gould.

Table (D) Messrs. C. H. Kilmister, H. W. A. Carter, E. J. Warner, F. Walker, J. S. Miller, W. Matthews, J. W. Sutton, J. S. Whatton, F. W. Dunn, H. Pywell, G. A. Miller, G. P. Miller, J. Ward, H. Cook, T. Beaton, J. Oswald, J. Brown R. F. Mogridge, J. Newson, J. Boot, W. A. Dickson, and J. N. Boot.

Table (E): Messrs. G. Cutler, W. Cutler, W. Davey, F. Cutler, C. Brantsen, F. R. Durham, and S. Cutler, Junr, (Chairman). The other gentlemen at this table are press representatives.

Table (F): Messrs. A. W. Marshall, A. E. Nash, R. Marshall, J. Sprakman, G. Woodruff, — Wilkinson, W. Paterson, H. S. Chapman, G. H. Robus, E. King, H. E. Yarrow, B. H. Soulsby, H. Stevens, H. N. Stevens, F. P. Hughes, E. Hughes, Hedley Hughes, Harry Hughes, A. M. Hughes, C. E. Cole, R. Cooper, G. T. Bullock and L. H. Rugg.

Table (G): Messrs. H. Capsey, A. E. Penn, A. E. Haeriel, A. J. Mack, T. C. Cordock, J. G. Sneath, T. Gibbins, C. F. Hill, A. E. Mohring, F. C. Haste, A. Bazire, F. H. Wedge, G Canning, D. N. Hunt, A L. Ressich, J. Sneath, L. S. DeRitter, A. Burgess, F. L. Rowe, F. A. Sowerby, and W. H. DeRitter.

Table (H): Messrs. E. J. Mears, S. Osborne, H. T. Smith, H J. Coventry, A. H. Stanley, E. C. Whitby, P. W. Palmer, P. Marshall, W. A. Tookey, R. Hunter, C. J. Leason, G. Edwards, L. Eedy, B. T. King, F. Mitchell, E. Eade, A. O. Ayres and P. L. Young.

The Junior Institution of Engineers.

The coming of age dinner of the above society was held at the Hotel Cecil on Saturday last, under the presidency of Mr. W. H. Lindley, M.Inst.C.E., F.G.S. Among those present were Lord Reay, G.C.S.I., the Venerable Archdeacon W. M. Sinclair, D.D., Mr. J. H. Balfour Browne, K.C., Mr. James Swinburne, M.Inst.C.E., Professor J. A. Ewing, Dr. R. T. Glazebrook, Professor W. E. Ayrton, etc., etc.

The president, in giving "The City and Port of London," referred to the proposed dockisation of the Thames. He remarked that a dam would greatly limit the tidal column sweeping up and down the river, and it would be necessary to utilise artificial means for doing the work which the tide might be made to accomplish. He suggested that the method successfully adopted at Bremen, whereby the force of the tide was skilfully directed towards scouring the channel and otherwise maintaining the waterway in a state of efficiency, might be applied to the Thames.

Archdeacon Sinclair, in responding, acknowledged the immense indebtedness of the City to engineers, then appealed for consideration for St. Paul's when the engineers were preparing further burrowings for tube railways.

Lord Reay, in proposing the toast of the evening, congratulated the members on having built up in twenty-one years an association which took a foremost place among the institutions of the country. The engineering profession was one which inspired those outside with esteem and respect. In the engineering profession there was no opening for amateurs or quacks; an engineer who was not up to the work was soon found out. He spoke with great admiration of the engineering profession because of the experience he gained while Governor of Bombay. The five years he was in charge of the public works department had induced high admiration for the energy and ability displayed by the profession which had conferred the greatest benefits on India. Upon the railways the present prosperity of Indian trade rested; they were an important element in frontier defence, they enabled the Government to successfully grapple with famine. Only by great irrigation works had agriculture been made possible in Sind and elsewhere, and the success of drainage systems in the towns was evidenced in the health statistics. The future of the empire depended in many respects upon the skill they would display in carrying out their profession in the colonies.

The health of the Secretary, Mr. W. T. Dunn, was proposed by the President, and was accorded with musical honours.

New Departures in Railway Working.

Some very interesting remarks illustrating the effect of modern conditions upon suburban railway traffic were made at the 141st half-yearly meeting of the London and South-Western Railway Company, by the Chairman, Sir Charles Scotter. There had, he said, been several new departures in railway working in the past year. For the first time in railway history electric traction had been used on lines which had been constructed for steam traction, and the two systems of working had been simultaneously in operation on the same lines. It was impossible to state what might be the ultimate results of these experiments. Within probably, about three months, the railway belonging the the South-Western Company between Putney-bridge and Wimbledon would be worked by the District Company, all of whose trains would be carried over that section of the company's line, and also up to Richmond, by electrical traction. Another new feature had been largely developed during the past year in the shape of rail motor-cars. The South-Western and the Brighton Companies were the pioneers in regard to this mode of working. So far back as June, 1903, they began working a rail motor-car over the Southsea branch, which belonged to them jointly, between Fratton and Southsea; and he might state that the cost of working that branch has been very considerably reduced, while the traffic had slightly increased. Experiments of the same kind were being made in other directions. In fact they had the system in operation on the Botley and Bishop's Waltham branch of their line, and they intended to try it on those branches where the traffic was small. He was sure they would thus be enabled to give a better service to the public and at less cost to the company. As he had said, the Brighton and South-Western Companies first used the rail motor-cars on their Southsea branch, but since then the Great Western, the Great Northern, the Midland, the North-Eastern, and many other companies had adopted the same method of working on their small lines. Then there were the road motor-omnibuses, which were provided to act as "feeders" to the railways. He must say that so far as they themselves were concerned, their experience of these omnibuses had not been very satisfactory. They had not succeeded in getting the proper omnibus, but they were gaining experience daily, and they hoped by these omnibuses to be able yet to deal satisfactorily with certain districts which were now cut off from railway accommodation, and thus bring the people to their line. Another new development was in connection with automatic signalling, which had so far worked very satisfactorily on their line, and the system would be extended as opportunity offered. Last, but not least, he might mention that the company had also recently adopted a mechanical fog-signalling apparatus, which did them great service during the disastrous fogs at the end of the year, and which, he was assured, relieved a large number of their servants from great risks.

Mr. C. T. Yerkes and the District Railway.

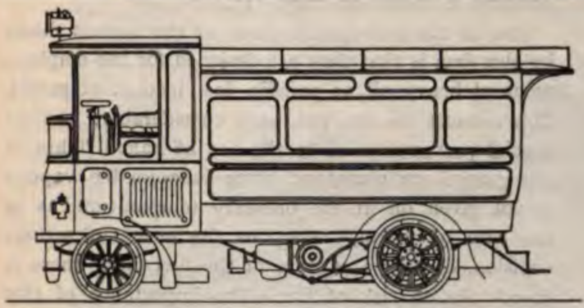
The election of Mr. Charles Tyson Yerkes to the chairmanship of the Metropolitan District Railway places him in a vastly important position in relation to electric traction in the Metropolis, which owes more to Mr. Yerkes and to Sir George White, the one an American and the other a Bristol financier, than to any enterprise on the part of London itself. Sir George White has retired from active participation in the progress of electric traction in London, but Mr. Yerkes, who succeeded Sir George as chairman of the London United Tramways, is also at the head of that important enterprise the Underground Electric Railway, which in addition to owning a controlling interest in the District Railway and the London United Tramways, is dominant partner in the Baker Street and Waterloo Railway, the Great Northern, Piccadilly and Brompton, the Charing Cross, Euston and Hampstead, and the Hampstead and Edgware lines.

MR. CHARLES TYSON YERKES.

Tramways and Light Railways Association.

At the ordinary general meeting of the Tramways and Light Railways Association, held on Friday last, Mr. Arthur Stanley, M.P., was elected president for the ensuing year. Mr. Alfred Baker, the president, was in the chair. The main objects of the Association are to promote, encourage, and facilitate the construction, extension, and working of tramways and light railways, to develop electric and other modes of mechanical traction, and to give to the Legislature and to public bodies and others facilities for conferring with and ascertaining the views of persons engaged or interested in the construction, working, and development of tramways and light railways. The following gentlemen were elected to fill vacancies on the council: Mr. H. England, Mr. J. B. Hamilton, Mr. J. H. Rider, Mr. S. Sellon, and Lord Vaux of Harrowden. The President in the course of his observations said he believed that if anybody invented a cheaper mode of traction than that of a metal wheel on a metal rail it would run them off the road, but it would not be done by motor omnibuses.

The entry of the picture post-card into business affairs has been chronicled on several occasions in PAGE'S WEEKLY. The latest instance is such a charming little card, entitled "His Private Secretary," which we have received from the Yost Typewriter Company, Ltd. The picture is not spoilt by advertising matter, and the Yost Typewriter Company, Holborn Viaduct, E.C., offer to send one on receipt of a stamped addressed envelope, to any reader mentioning this journal.



LONDON AND SOUTH-WESTERN RAILWAY OMNIBUS,
BY CLARKSON, LTD.

THE OLYMPIA MOTOR SHOW.

(*Continued from page* 287.)

THE BROTHERHOOD CAR.

Something approaching a sensation has been created among automobile engineers by the new All British Brotherhood car, for the engines of which the firm of Peter Brotherhood are responsible. Innovations are introduced in almost every detail, and some of these are shown in our illustrations. The self-regulating carburetter (fig. 1), is one of the most striking features, and while it is capable of adjusting the explosive mixture to a very fine degree, it is not in itself constructed delicately or with any excessive complication as is generally the case with automatic carburetters. The petrol supply passes through a long tapered jet with a very ample bore, but is controlled to a fine degree with a long needle, and consequently is not subject to the occasional blockages which occur in the case of the usually fine petrol jet that the slightest foreign matter will choke. Moreover, the parts controlling the various functions of the carburetter being all connected to one spindle cannot get out of adjustment with each other. It is claimed that it automatically assures the even and quiet running of the motor at low speeds.

The ignition is high tension on special single Cartridge coil and trembler only from four cylinders. The commutator (fig. 2), and high tension distributor are mounted on one car on dashboard.

The gear changing is arranged so that missing gear is rendered impossible, and the case of control, through the clutch pedal and the throttle, will appeal to the practical man. The radiator has the tubes staggered and so arranged as to assure cool air, coming in contact with all surfaces of tubes and fires. There is a new design of compensated bank brake made of two semi-circular stiff steel bands, carried on two pivots, accurately machined, so as to exert uniform pressure on all points of contact with circumference of brake

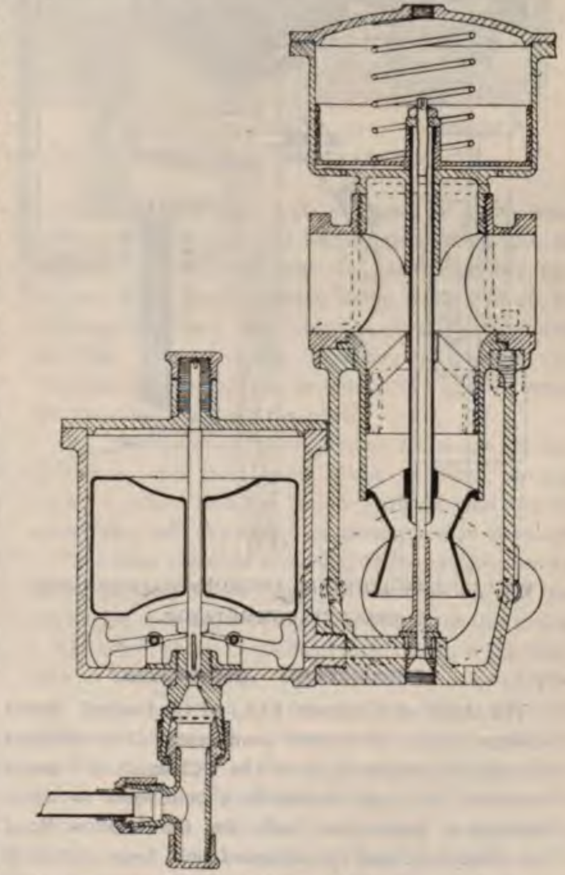


FIG. 1. SECTIONAL ELEVATION OF CARBURETTER.
BROTHERHOOD-CROCKER MOTORS, LTD.

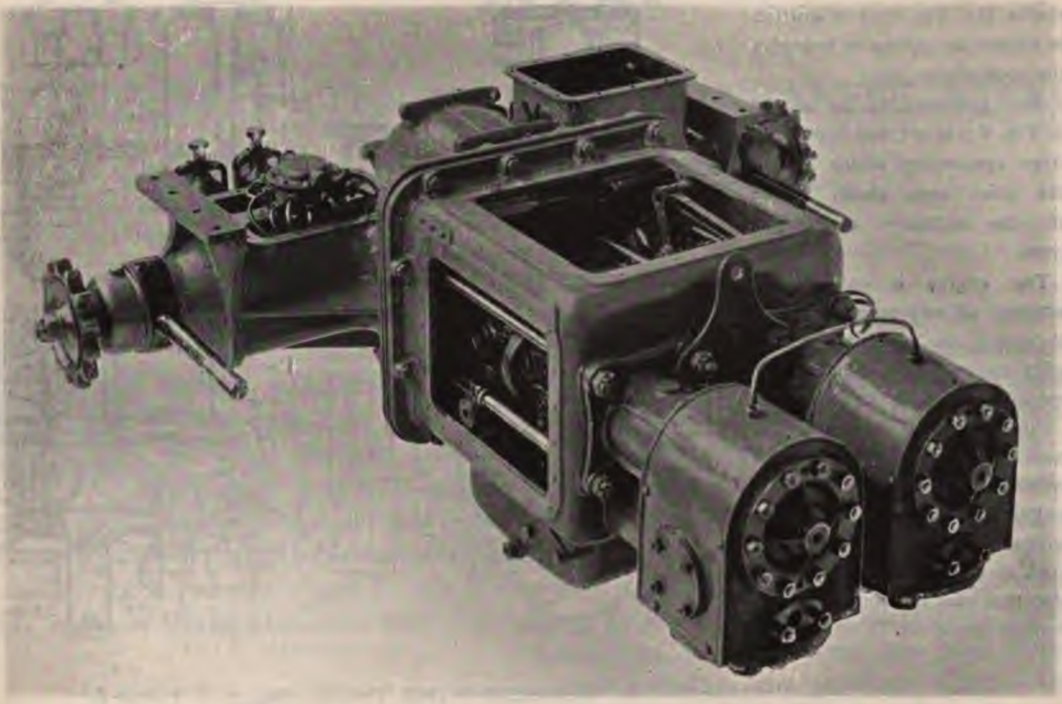


FIG. 4. STANDARD "CHELMSFORD" ENGINE, WITH COVER OFF, BY CLARKSON, LTD.

bolt, which, when lifted up, fits into a slot in the arm. This arm carries on the inside a spherical head, which closes the release compression port, a washer being used to make a gas-tight joint. Provision is made to hook the arm up to the carburetter when the compression on any cylinder is released. The advantage of this device are obvious enough, the primary intention, being, of course, to facilitate the removal of a valve from any cylinder while the engine is running, while the arrangement of the parts permits the replacement of a sparking plug without stopping the motor. Accessibility to the crank case has also been an object in design. The motor runs up to 1,000 revolutions per minute, developing 30 h.p., with cylinders of 4½ in. bore by 5 in. stroke, but the best speed at which to run the motor is 700 revolutions per minute.

CROSSLEY PETROL ENGINE.

This engine which is shown by Messrs. Charles Jarrott and Letts, Ltd., is made by Messrs. Crossley Bros., of Openshaw. The illustrations show transverse and longitudinal sections, with an end elevation and plan. One of the most striking features of the engine is the valve which varies the volume of the charge drawn into the working cylinders. A reference to fig. 5 will show that the inlet-valves, A, and the exhaust valves, A1, have their seats arranged on a somewhat lower level than the port leading from them into the working cylinder, and that the gases therefore tend to pass more equally around them, instead of on the cylinder side only, this being particularly important for the exhaust-valves, because it reduces the tendency for the valve to be heated to a greater extent on the one side than the other.

The cylinders and their pistons are made of hard cast iron, and their exact shape is shows in figs. 5 and 6, where also the hollow gudgeon pins and the connecting rods are shown sectionally and in elevation.

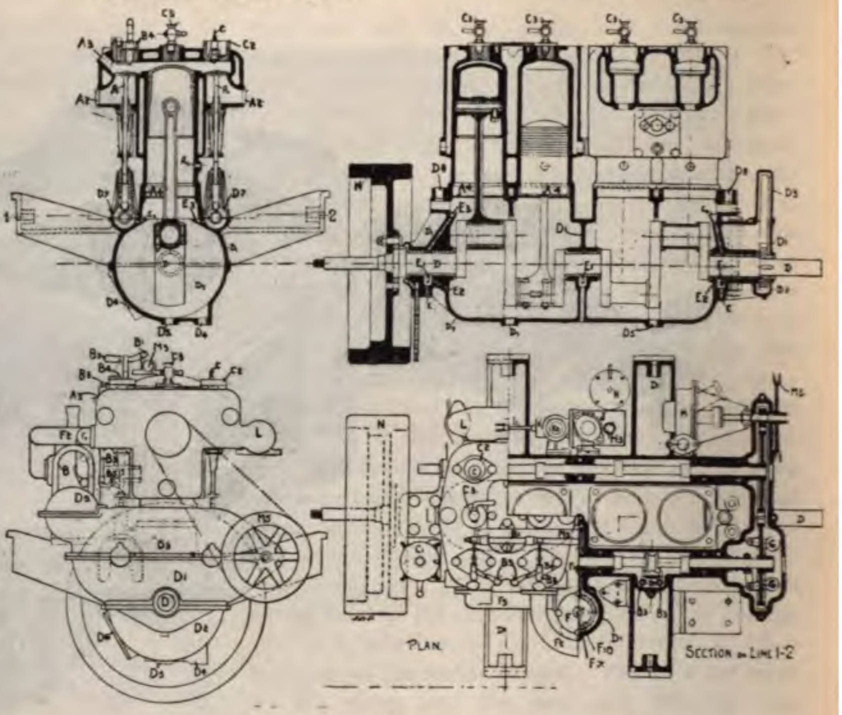
The crank chamber is so shaped that it encloses the lower portions of the gear wheels drawing the cam shafts and a separate casing, D3, completes this casing

The crank shaft, D. made of nickel steel, is machined all over from a forging. Messrs. Crossley have adopted the special system, developed by them for their ordinary gas-engine crank shafts, which will be familiar to readers of PAGE'S WEEKLY, for this four-throw crank shaft. The flywheel, N, is fixed to the crank shaft by bolts passing through a registering flange, which forms a part of the solid forging. The igniters, B4, are operated by the disc-cams, two of which are seen on the inlet cam shaft in fig. 8, these cams engaging with projecting arms mounted on the lower ends of the vertical rock-shafts, B3. The time of ignition is varied by raising or lowering the rock-shafts, B3.

The governor, G, is shown in Fig. 8; it is fitted inside the large spur-wheel which drives the inlet cam shaft. It is of the ordinary centrifugal type.

The engine is capable of working at any speed between 80 and 1,200 revolutions, this wide range being due to the specially-designed carburetter.

Fig. 5 herewith shows vertical cross section through one of the cylinders. Fig. 6 shows vertical longitudinal section through centre of engine. Fig. 7 is a front elevation. Fig. 8 is a part plan and part horizontal section through cam-shaft.



CROSSLEY PETROL ENGINE, FIG. 5, 6, 7 AND 8.

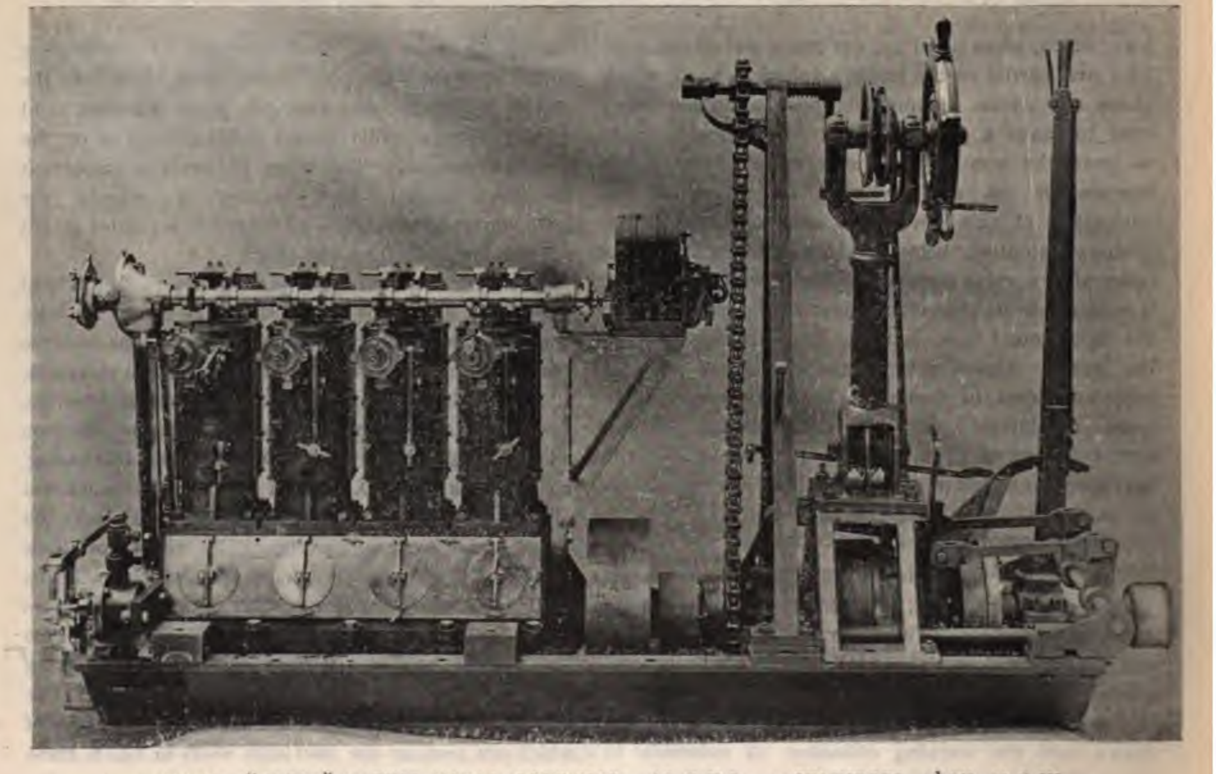


FIG. 9.—"CLIFT" MARINE MOTOR, PORT-SIDE. 30 B.H.B. 4 CYLINDERS, 4½ IN. × 5 IN.

HADFIELD'S PATENT "ERA" MANGANESE STEEL IN CRUSHING MACHINERY.

THE Hadfield and Jack's Patent Gyratory Crusher, illustrated in figs. 1 and 2, is one of ten which have been constructed for the Premier Diamond Mines to deal with approximately 800 loads of blue ground per hour. It is the latest product of the two large machine shops which have been recently added to the East Hecla Works of Messrs. Hadfield's Steel Foundry Company, Ltd., Sheffield, for the construction of Stone and Ore Crushing Machinery. The machine is of particular interest because it represents one important practical outcome of the research work which has earned the Hadfield Company such a wide reputation in the metallurgical world. The importance of lightening this class of machinery needs no emphasis. In the present instance it has been secured by the institution of cast steel parts for constructions in which cast iron was formerly employed, while the portions of the Crusher most subject to wear and tear have been as it were, "armoured" with "Era" manganese steel, thereby ensuring for them a considerably enhanced durability.

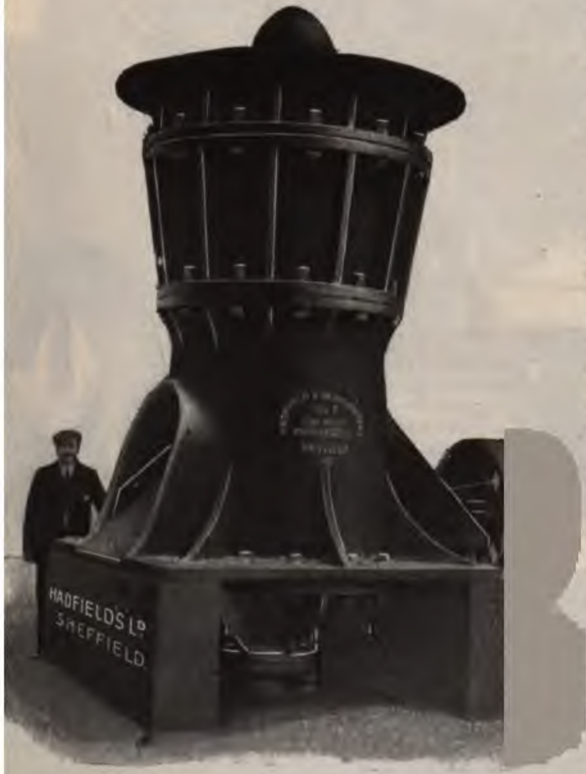


FIG. 1. HADFIELD AND JACK'S PATENT HECLON GYRATORY CRUSHER.

The Heclon Crusher has also a number of mechanical improvements which make for reduced frictional resistance, and provide for the protection of the interior mechanism from dust. Its construction will be readily understood from fig. 2. The lower part of the body portion of the breaker is of cast iron, the upper part being of cast steel lined with concave plates of "Era" manganese steel. The hopper, of cast steel, carries a 3-arm spider supporting the boss.

The shaft T is hollow, fitting over and protecting the eccentric, which is also guarded from dust by the dust-collars V and S1. Its weight is carried on a brass ball bearing at the upper end where the motion is practically nil. The crushing-cone, of "Era" manganese steel, is not revolved by the shaft, but has an oscillatory motion transmitted through the shaft by an eccentric boss cast in the base gear wheel G, the thrust from the eccentric being taken by a steel sleeve C, which is securely attached to the cast iron bed-plate. The worm-wheel, shown at the lower end of the shaft I, serves to wind it up or down, thus regulating the degree of fineness to which the blue ground is to be reduced. The actual crushing parts of the machine are lined with "Era" manganese steel, which can be renewed.

The bushes between the sleeve C and the inner surface of the eccentric boss and also between the outer surface of the latter and the inner surface of the shaft, are of anti-friction metal, and can easily be withdrawn for examination.

The lubricating system is carried from a base situated above the level of the main bearing, the oil passing through a hole bored in centre of shaft. A constant drip of oil is maintained, and after passing over the inner and outer bushes, finds its way under the dust ring S1, and partly past the inner bearing down to the base plate whence it is recovered through a small pipe in the bottom-plate.

The machine is driven by a pulley through the medium of safety breaking pins and a bevel pinion on the wheel G, the shaft bearing being exceptionally long and lined with anti-friction metal.

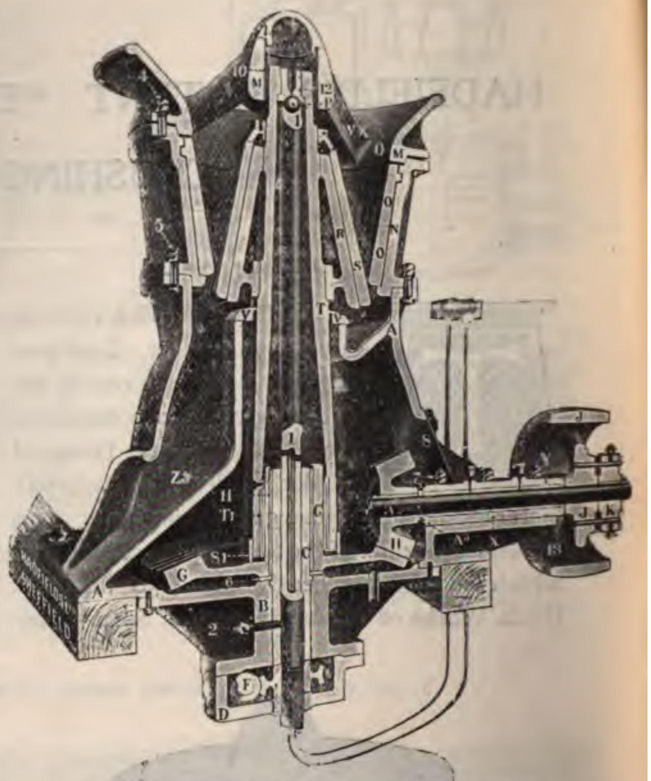


FIG. 2. SECTION OF THE HECLON CRUSHER.

The other machines, figs. 3—6, illustrate further applications of the "Era" manganese steel to crushing machinery. In fig. 3 is shown a special type of revolving screen designed by Hadfield's Steel Foundry Company, Ltd., best toughened cast steel in this case being used for all the parts subject to heavy working strains. When so required, these screens are fitted with perforated plates of "Era" manganese steel.

The use of this special metal for the jaw-faces, side-cheeks, toggle-plates and grooves in the reciprocating stone-breaker is illustrated in figs. 4 and 5, and here, again, cast steel parts have

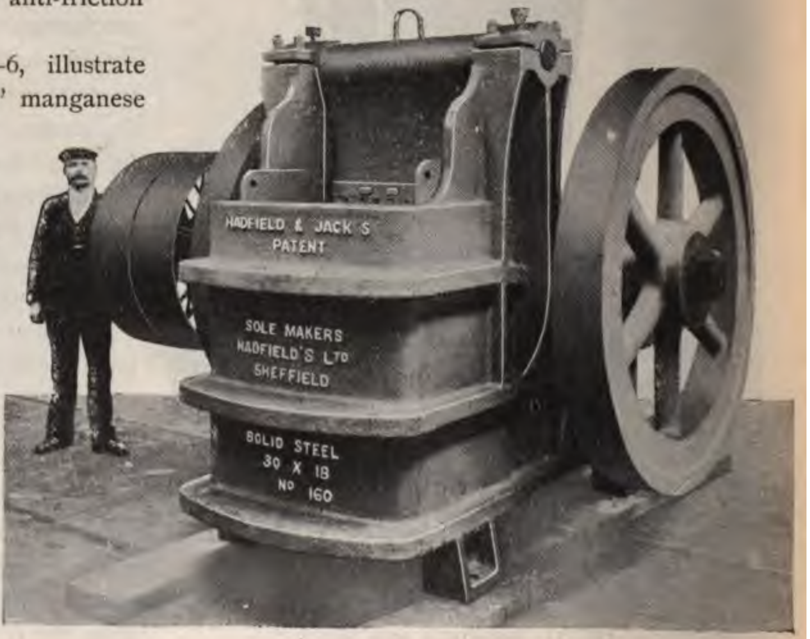


FIG. 4. HADFIELD'S PATENT SOLID STEEL JAW CRUSHER

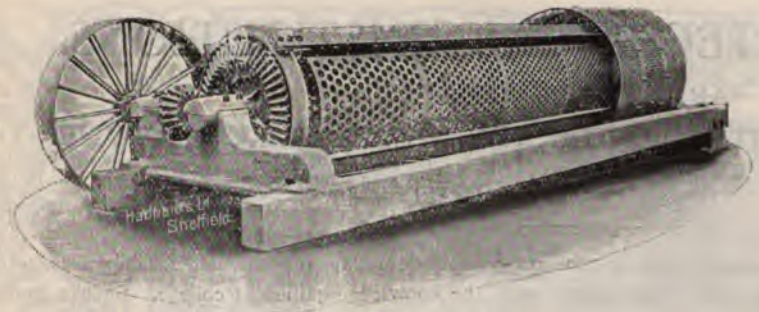


FIG. 3. REVOLVING SCREEN.

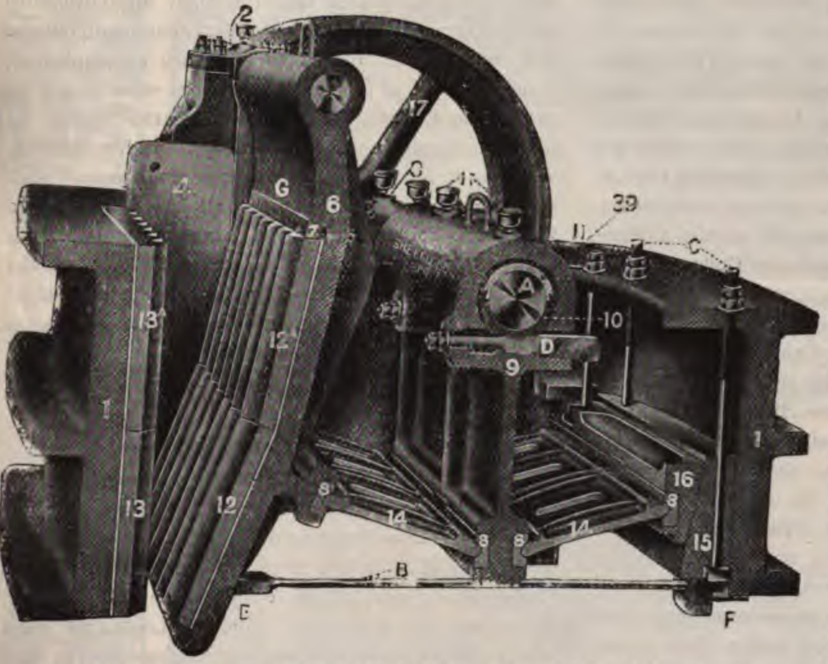


FIG. 5. SECTION OF HADFIELD'S PATENT SOLID STEEL JAW CRUSHER.

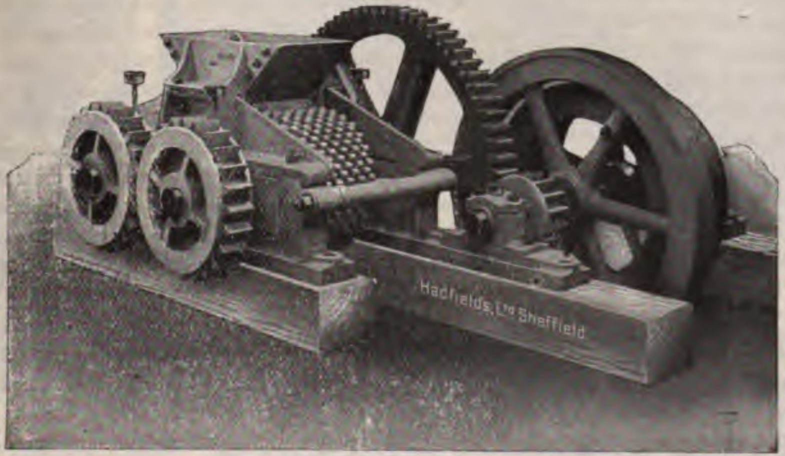


FIG. 6. TOOTHED CRUSHING ROLLS (GEAR DRIVEN).

been introduced with marked effect upon the weight. The back of the jaw-face has V grooves filled with hard spelter, which permits it to be slipped into place with the same readiness as a cast iron jaw-face with a planed back, and ensures equally as good a fit.

Similar metals are used in the construction of the crushing rolls (fig. 6), intended for dealing finally with partly-crushed material. In this case the use of "Era" manganese steel enables the teeth of the rolls to be made of thinner and longer section, thereby procuring better results and also a longer life for the teeth than was formerly possible by the use of chilled iron.

It may also be mentioned that "Era" manganese steel plays an important part in the production of links, pins, sprocket wheels, and other parts of elevators and conveyors which are specially subject to heavy wear and tear. In fact, this special steel is particularly applicable wherever there is severe abrasive action and, we are assured that in many cases Messrs. Hadfield, Ltd., are able to show records of wear in the ratio of 5 to 1, 6 to 1, and even more as compared with iron.

NOTABLE TECHNICAL INSTITUTIONS.

ARMSTRONG COLLEGE
(IN THE UNIVERSITY OF DURHAM), NEWCASTLE-UPON-TYNE.

By STANLEY PARKER SMITH, B.SC.

SITUATED in the very heart of one of the most important engineering centres of the United Kingdom, the Armstrong College ranks among the foremost institutions in the world for the training of engineers. The name of the College, formerly known as the Durham College of Science, has been recently changed to the Armstrong College, in memory of the late Lord Armstrong, a name which will probably be regarded by engineers as signifying that engineering is looked upon as amongst the most important of the various subjects taught at the College, which is one of the chief University Colleges in the country. Like many other institutions of its kind, it has had a hard struggle to establish its claim as a training ground for modern and scientific engineering; nor can the victory yet be said to be quite won, as it is only by the recognition of those who have done well, after successfully going through the College course, that the prejudice against university men can be overcome. There are still many engineers on Tyneside, as well as elsewhere, who hold that young apprentices can gain their experience as their fathers and forefathers did, and that a college man is lazy or incompetent. They seem to forget that, when they began their career, engineering in all its branches was conducted on vastly different lines. Of late years science has been so applied to the arts that, unless a man has received a thoroughly scientific education, he cannot hope to reach the highest ranks of his profession.

The chief firms in the district are now beginning to recognise the claims of the College, and to look upon it as a desirable and necessary institution; in fact, in many cases, these firms work hand-in-hand with the College. The college course is not intended to be a substitute for the term of apprenticeship, but it is so arranged that the student apprentice may benefit to the fullest possible extent by the combination of his scientific and practical training.

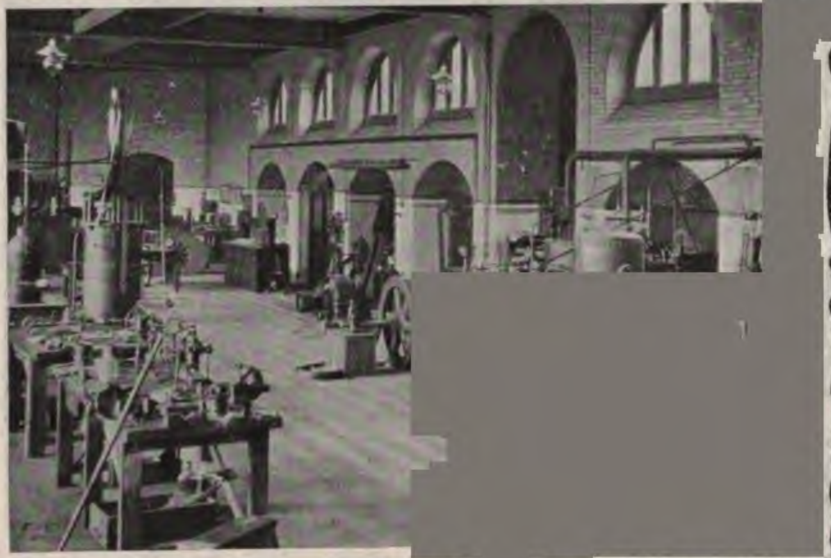
METHODS OF TRAINING.

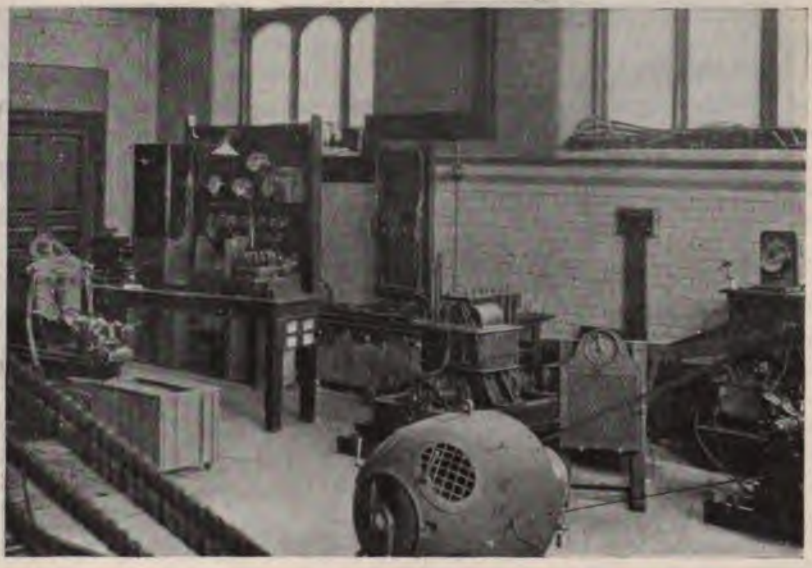
Many of the students enter on the "sandwich" system, by which they combine the experience gained in various drawing offices, works, shipyards, etc., with the knowledge gained at college. Such a course often extends over five or six years—two or three sessions at college and two or three years in the shop. Other students prefer to serve their apprenticeship first and then come to college, whilst others again reverse this order. With regard to the work accomplished, it may be first of all pointed out that when any man enters the College, he very soon learns that if he wishes to attain success he must work, and work hard. Whether it is right or not to crowd four years' work into three, is another matter; but it is a well-known fact in the College that unless a man chooses to work hard he will not earn his degree or diploma, as the case may be. On the other hand, this is one of the chief causes that makes the engineering degrees and diplomas of this university so highly valued.

ENGINEERING STAFF.

In describing some of the chief features of the College of interest to engineers generally, we may in the first place devote a few words to the engineering staff. Each branch of engineering has its own lecturers; the head of the engineering department being Professor Weighton, M.A.; of the mining department, Professor Louis, M.A.; and of the electrical department, Dr. Thornton, M.I.E.E. Of Professor Louis we need add little to what was said in a biography of him which appeared in a recent number of PAGE'S WEEKLY. He holds that before anything else, a student must be a man of character, and although he may rise to positions of eminence and responsibility, he must always continue to progress, for as soon as a man ceases to acquire knowledge his usefulness begins to decrease. Professor Weighton is one of the most respected men in the College. He is admittedly master of his subject—his wide experience being gained from years of practice and study. His personality is such that he commands esteem from all his students, in whom he takes great interest.

Dr. Thornton is probably best known to the outside world by his valuable experimental researches which have been dealt with from time to time in the technical press; but among the College students, there is a deep feeling of respect for him in consequence o

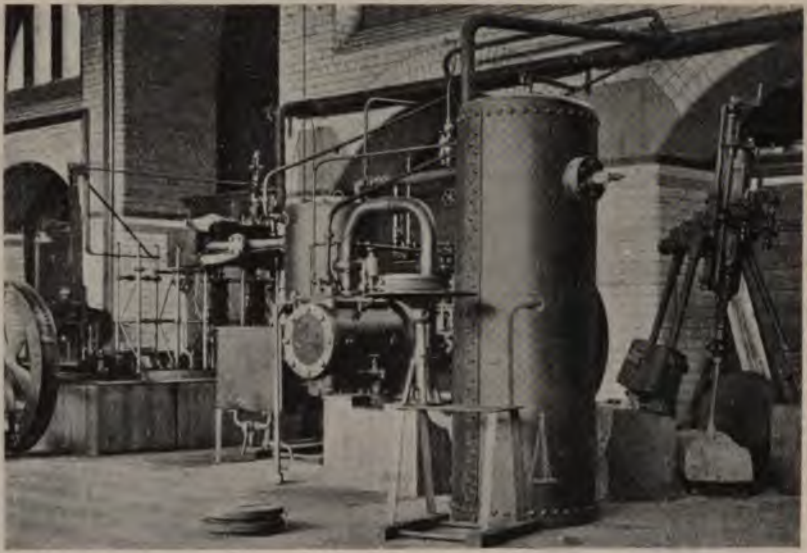




IG. 1. GENERAL ARRANGEMENT OF THE ENGINEERING LABORATORY, ARMSTRONG COLLEGE.

FIG. 2. A CORNER OF THE ENGINE ROOM

I.



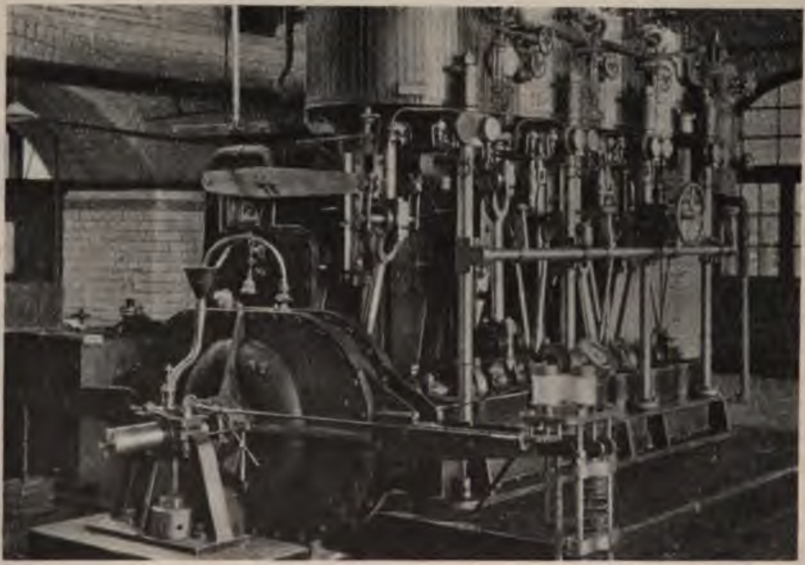


FIG. 3. MINING MACHINERY AT THE ARMSTRONG COLLEGE.

FIG. 4. EXPERIMENTAL ENGINES.

his kind personal interest in their work. He is ever engaged in research, and delights to have the senior students under his guidance, doing any similar work that may appeal to them. Moreover, his own genial nature and dogged perseverance help them over endless difficulties which would otherwise prove most disheartening.

Every opportunity is taken of cementing the friendly relationship existing between the teaching staff and their students by means of social intercourse. At a recent engineers' dinner (which promises to become an annual function) Professor Weighton remarked on the goodwill existing between the different engineering sections of the College, and strongly emphasised the important position which the engineers hold there. He was glad to know that on the completion of the new buildings they would have a wing of the building practically to themselves. Professor Louis on this occasion mentioned that the College had supplied more Inspectors in Mining than any other in the kingdom, whilst its representatives in one form or another were to be found in almost every part of the world. An engineers' committee was formed as a result of this dinner to organise the engineering interests of the College. It is composed of members of the staff and representatives of the students, and has to look after the welfare of considerably more than one hundred students.

THE COLLEGE COURSES IN ENGINEERING.

We will next describe briefly the courses of study undertaken at the College. They may be divided into three classes: (i.) Degree of B.Sc.; (ii.) College Diploma; (iii.) Special Courses.

(i.) The course for the B.Sc. in Engineering may be taken in any of the following branches: (*a*) General Mechanical Engineering; (*b*) Naval Architecture; (*c*) Civil Engineering; (*d*) Electrical Engineering (including Mechanical Engineering); (*e*) Mining; (*f*) Metallurgy. These courses extend over three years. FIRST YEAR.—This is a preliminary course in general science, and is the same for all men taking their degree in any branch of technology. There are four subjects—mathematics, physics (theoretical and practical, chemistry (theoretical and practical), and mechanical drawing. SECOND AND THIRD YEARS.—In the second year the engineers begin to specialise, the various courses being chosen from the following subjects in the second and third years: applied mechanics, engineering and engineering laboratory, mechanical drawing, naval architecture, surveying, practical geology, electrical engineering and laboratory, conomic mineralogy, mineral deposits, mining, dressing of minerals, general metallurgy and assaying, etc. In addition to the above, most of the degree students are required to take auxiliary subjects, such as physics chemistry, or mathematics.

(ii.) The diploma courses extend over two years for a second-class certificate and three years for a first-class. The diploma may be taken in: (*a*) engineering (including electrical engineering); (*b*) naval architecture; (*c*) mining. The subjects taken are the same as above, but are modified to suit each special case.

(iii.) The special courses are arranged to meet individual requirements.

THE COLLEGE BUILDING AND THE HOUSING OF DEPARTMENTS.

Each branch of engineering has, or will shortly have, on the completion of the new buildings at the College front, its own class-rooms, and laboratories. The Engineering Drawing Office, which measures 123 ft. by 34 ft., is one of the finest rooms in the building. The Engineering Laboratory — which is beneath the Drawing Office and is of similar dimensions, is fitted with all kinds of experimental machinery, etc. The general arrangement is shown in fig. 1. In this laboratory the junior students are made to perform a series of experiments to illustrate the first principles given in the classes.

The chief pieces of machinery in this laboratory are a set of vertical quadruple-expansion experimental engines (fig. 4). These engines are capable of working up to 200 i.h.p., at 160 revolutions per minute, with a boiler pressure of 210 lb. per square inch. They are surface condensing, and are so constructed as to be capable of being worked quadruple, triple, double or single expansion, under any required conditions of steam pressure or total expansions of the steam. The cylinder ratios, the cut-off in each cylinder, and the crank angles can be altered at will. The dynamometer is of the Froude hydraulic type, and is fitted with automatic recording gear for both the b.h.p. and revolutions in a given time. The several parts of the engines and boiler (which is of the multitubular marine return-tube type) were constructed, and presented to the College, by forty-six different firms from designs by Professor Weighton.

The vertical testing machine is of the Buckton type, and is capable of testing materials up to 100 tons in tension, compression, sharing and cross-breaking It is worked by a hydraulic intensifier, and is fitted with autographic apparatus for recording the relation between stress and strain. This machine was presented to the College by Mrs. Clarke in accordance with the wishes of her husband, the late Mr. William Clarke, of Gateshead. The senior students, for one term, receive demonstrations from Mr. Cullen, the lecturer in engineering, on the uses of the testing machine, and two terms are spent in trials on the experimental engines, and lectures by Professor Weighton on results obtained by trials. There is always some research going on in connection with these engines.

There is also a direct steam-driven air compressor of the Ingersoll-Sergeant type and a rock drill by the same firm (see fig. 3). There are also shown in fig. 1 a gauge-testing machine, a Westinghouse pump, and a six-pole dynamo (given by the Pallion Company, Sunderland), connected by belt to a 15-h.p. compound steam enigne. On the extreme right of this photograph is seen the dynamometer of the experimental engines, whilst on the left is seen the intensifier of the testing machine. Fig. 2 shows a corner of the engine-room, where several pieces of electrical machinery and apparatus are placed until the new electrical laboratory is finished. When these machines, etc., have been moved to their right place, space will be afforded for a new steam plant and a motor generator set.

The principal machines at present in the engine-room include a set of Robey's horizontal compound steam engines, presented by the Worshipful Company of Drapers of the City of London. They are capable of indicating 200 h.p., with steam of 140 lb. pressure, and are coupled by a rope drive (seen in the photo) to a line of shafting, and also to a Holmes' compound dynamo capable of giving 500 amperes at 103 volts. Two useful 5-kilowatt electric machines, by Messrs. J. H. Holmes and Co. and Messrs. Scott and Mountain, are capable of being worked as generators or motors, on continuous circuits or alternating circuits of one, two, or three, phases. There is also a Duddell oscillograph shown, which is generally being used for research work. This instrument was presented by the late Mr. James Hall of Tynemouth. Other machines are a 30-kw. Parsons turbo-generator; a 20-kilowatt motor generator (given by the Newcastle-upon-Tyne Electric Supply Company); a 20-kilowatt motor (both of these work on 480 volts); a 5-kilowatt single-phase induction motor; about twelve transformers of different ranges and makes; liquid resistances; experimental switchboards; ammeters, voltmeters wattmeters, etc., of all descriptions; various lathes, drills, and other machinery and instruments of different kinds, including standardising sets used for accurate tests and experiments.

The metallurgical laboratory includes the usual furnaces for assaying and for research work. There are experimental ore dressing appliances and a small rock breaker, and also facilities for practice in panning and vanning.

In conclusion mention may be made of the advantages the engineering students derive from having such eminent men as Drs. Stroud and Bedson as professors of physics and chemistry; also Professors Jessop and Lebour in mathematics and geology, whilst the auxiliary subjects are continually being made more suitable for engineers.

One of the most prominent features in the College is the amount of original resarch done there, which is greatly aided and encouraged by the new principal—Sir Isambard Owen. The College owes very much to its position in an important centre of industry. It is surrounded by great shipyards, engineering works, collieries and ironworks, in which students are given every opportunity of gaining an insight into the practical side of the technical subjects taught at the College.

Although the above description of the purely engineering side of the College is of chief interest to the engineer, yet we might also mention that in the other departments there are, besides those mentioned, Professors in biology, botany, agriculture, classics, English literature and education; whilst there are lecturers in metallurgy, crystallography, history, modern languages, philosophy, art, etc. We might also take this opportunity of mentioning that Mr. Stanley, lecturer in metallurgy, has just been appointed to an important professorship in metallurgy in South Africa.

ICE ON THIRD RAIL.

LAST winter several electric railways in the States experienced considerable difficulty with sleet and ice forming on the third conductor rail. The climatic conditions of this country have not yet given trouble on our electric lines, but it is always a contingency which must be looked out for. Sticky wet snow or sleet are the greatest danger, and in order to remove this as it forms, a brush or cutter is employed. The latest pattern as adopted on the Brooklyn elevated railway consists of a hard maple block, into which are fixed sixteen rows of wire bristles, each row containing twelve sets. Each set of bristles consists of seven No. 23 B. and S. steel ribbons 1⅛-in. wide, and they are so arranged as to brush the rail surface broadside on. The brush is pressed downwards, with a pressure of 75 lb., and it is carefully insulated from the supporting guide bar by hardwood and fibre separators.

Deep Borehole Surveying.

AT the meeting of the Institution of Mining and Metallurgy, held yesterday, a paper on this subject by Mr. Hugh F. Marriott, was on the agenda.

The author describes the construction of two sets of instruments he has lately perfected for use in deep level borehole surveying. These instruments are the outcome of many years' experience and numerous experiments with various forms of apparatus for both mechanical and chemical action. A workable instrument must fulfil the two following requirements; with a continuously working instrument the operator must know what changes are being recorded by the instrument at the time such changes take place; and in an intermittently working instrument the operator must be able to absolutely unlock and lock the recording apparatus at will at the point at which it is required to take readings. The author finally turned to electricity as the only means of fulfilling the stringent requirements the circumstances demanded.

The illustration on page 356 refers to these two sets of instruments.

CONTINUOUSLY WORKING INSTRUMENT.

The earlier figure numbers refer to the continuously recording instrument for determining the variation in amount of dip in a deep borehole.

Fig. 1 is a vertical section of the instrument. Fig. 2 is a diagrammatic sketch of the electrical connections. Fig. 3 is a diagrammatic sketch of an alternative arrangement of the electrical connections. Fig. 4 is a vertical section of the cable head. Fig. 5 is a section of the lower portion of the cable head, showing the connections with the conductors for the current. Fig. 6 is a plan of the lower end of the cable head. Fig. 7 is a sectional elevation of a slightly modified arrangement.

The two wires or conductors *K*, *L*, which serve for passing the current of electricity through the instrument, may be connected up with a series of primary or secondary cells of ascertained electromotive force, a galvanometer, and a standard resistance box. The various resistances of the coil having been previously compared with those of the standard resistance box, the declination of the plumb-bob *F* from the vertical can always be ascertained by means of the galvanometer.

INTERMITTENTLY WORKING INSTRUMENT.

Fig. 8 respresents the instrument, removed from its casing, in part sectional elevation. Fig. 9 is an elevation of the top screw cap or plug. Fig. 10 is a plan of Fig. 9. Fig. 11 is a plan of the magnetic compass and mirror, detached. Fig. 12 is a plan of the resistance frame or coil, also detached. Fig. 13 is a sectional elevation of a modified form of the instrument, drawn to an enlarged scale. Fig. 14 is a plan of Fig. 13. Fig. 15 is a part sectional elevation of the tubular or cylindrical casing for the instrument. Fig. 16 is a transverse section of line x—x Fig. 15, and Fig. 17 is a plan of the cap or plug for closing the lower end of the casing.

After the magnetic compass *L* has been arranged in position on the needle *K*, which forms the pivot, molten paraffin wax, or other suitable material, is then poured into the tube until the lower portion of the compass attachment is well below the surface. The wax is then allowed to solidify, the top cap or plug *B* screwed into position, and the instrument then placed in the casing *P*, and the wires, $d, d1$ connected by means of the electric cable with a source of supply of electrical energy. In use the instrument is lowered in the bore-hole to the position required to be surveyed. A sufficiently strong current of electricity is then passed through the resistance frame or spiral wire *J* for a sufficient length of time to melt or liquify the mass of paraffin wax or other material in the tube *A*.

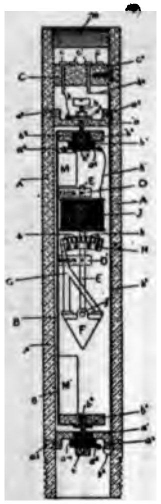


FIG. 1.

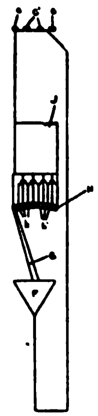


FIG. 2.

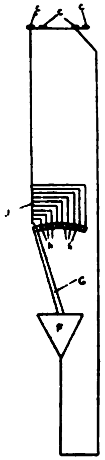


FIG. 3.

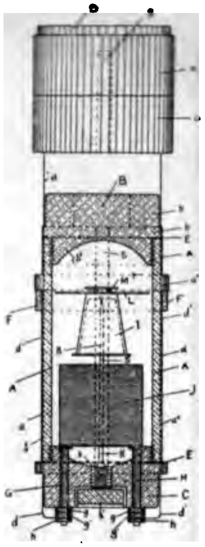


FIG. 8.

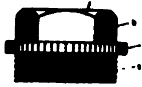


FIG. 9.

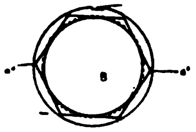


FIG. 10.

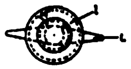


FIG. 11.

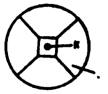


FIG. 12.

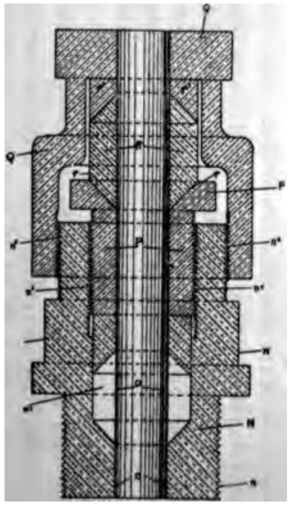


FIG. 4.

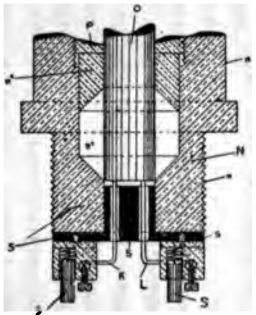


FIG. 5.

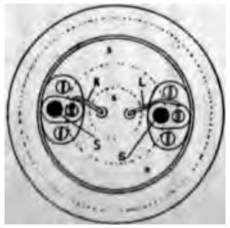


FIG. 6.

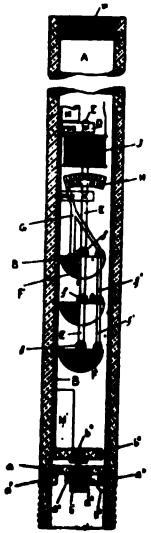


FIG. 7.

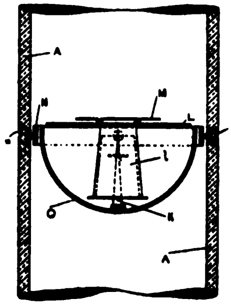


FIG. 13.

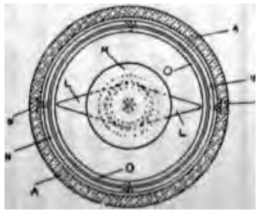


FIG. 14.

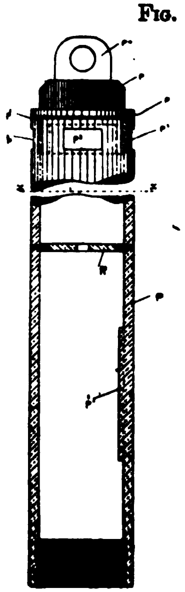


FIG. 15.

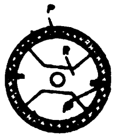


FIG. 16.

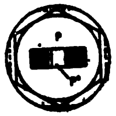


FIG. 17.

INSTRUMENTS USED IN DEEP-BOREHOLE SURVEYING.

The current is then cut off. Thereupon the compass *L* assumes its true magnetic north and south positions. The wax is then allowed to cool and re-solidify, after which the instrument is withdrawn from the borehole. The direction of dip may then be ascertained by observing the declination of the silver mirror *M* from the horizontal with regard to the direction of the compass *L*.

MODE OF WORKING.

The general arrangement of the apparatus when in working order is as follows: An iron headgear stands over the mouth of the borehole to be surveyed, and the geared drum carrying the electric cable stands at a convenient distance to the rear of this. In the headgear is a measuring wheel of extreme accuracy, a vital point where there are known obstructions at various points in the hole. The cable is ½ in. in diameter, and contains two highly insulated conductors. It is designed to support its own weight and that of the instrument in a waterless hole of 5,000 ft. depth if necessary.

One end of the cable is attached to the head above described, and the other is connected in the interior of the drum to two concentric contact rings, which are placed in communication, by means of carbon brushes, with the galvanometer in the continuouly recording instrument, or the source of electrical energy in the intermittently recording instrument. The galvonometer itself is of special design, and is calibrated to read, at a pressure of about 4 volts, the make-and-break records of the continuous clinometer, and it is also designed to record the rise in temperature indicated by an electrical thermometer.

The author gives diagrams of results obtained from surveys of two boreholes sunk on the property of the Turf Mines, Ltd., which were made with these instruments, and which bring out the service which they are likely to render to the mining industry.

INSTITUTION OF CIVIL ENGINEERS.

At the last ordinary meeting, Sir Guilford Molesworth, president, in the chair, it was announced that 19 associate members had been transferred to the class of members—viz., Messrs. W. Bates, E. T. Beard, O. F. L. W. Cuffe, C. R. Fenwick, C. O. Grimshaw, D. J. Highet, J. N. Kirby, C. N. Lailey, O. C. Lees, C. F. Marsh, E. H. S. Napier, H. W. Parkinson, J. S. Pickering, A. Powell, T. Pridham, G. Rankin, P. J. Sheldon, A. T. Snell, and E. R. Waight. The monthly ballot resulted in the election of seven members—viz., Messrs. F. Hellmann, J. B. Hunt, J. Inglis, D. Macdonald, C. B. Smith, Ma.E. (McGill), J. F. Sorzano, and G. W. Wolff, M.P., 20 associate members—viz., W. H. C. Clay, J. L. Cridlan, H. Dalgarno-Robinson, J. D. D. Davis, T. S. Ennis, B.E. (Royal), Don E. Ferro, B.A. (Colombia), E. P. Harvey, B.A. (Cantab.), A. G. F. Heather, L. H. L. Huddart, B.A. (Cantab.), W. C. Isle, B.Sc. (Victoria), J. M. Mackay, M. S. McKay, B.A., B.A.I. (Dubl.), (London), R. C. S. Murray, B.A. (Cantab.), I. V. Robinson, G. W. Shearer, B.Sc. (Glas.), A. O. Sherren, E. D. Simon, B.A. (Cantab.), P. B. le D. Tree, R. P. Wilson, and W. R. Wilson, B.Sc. (Glas.)

OBITUARY.

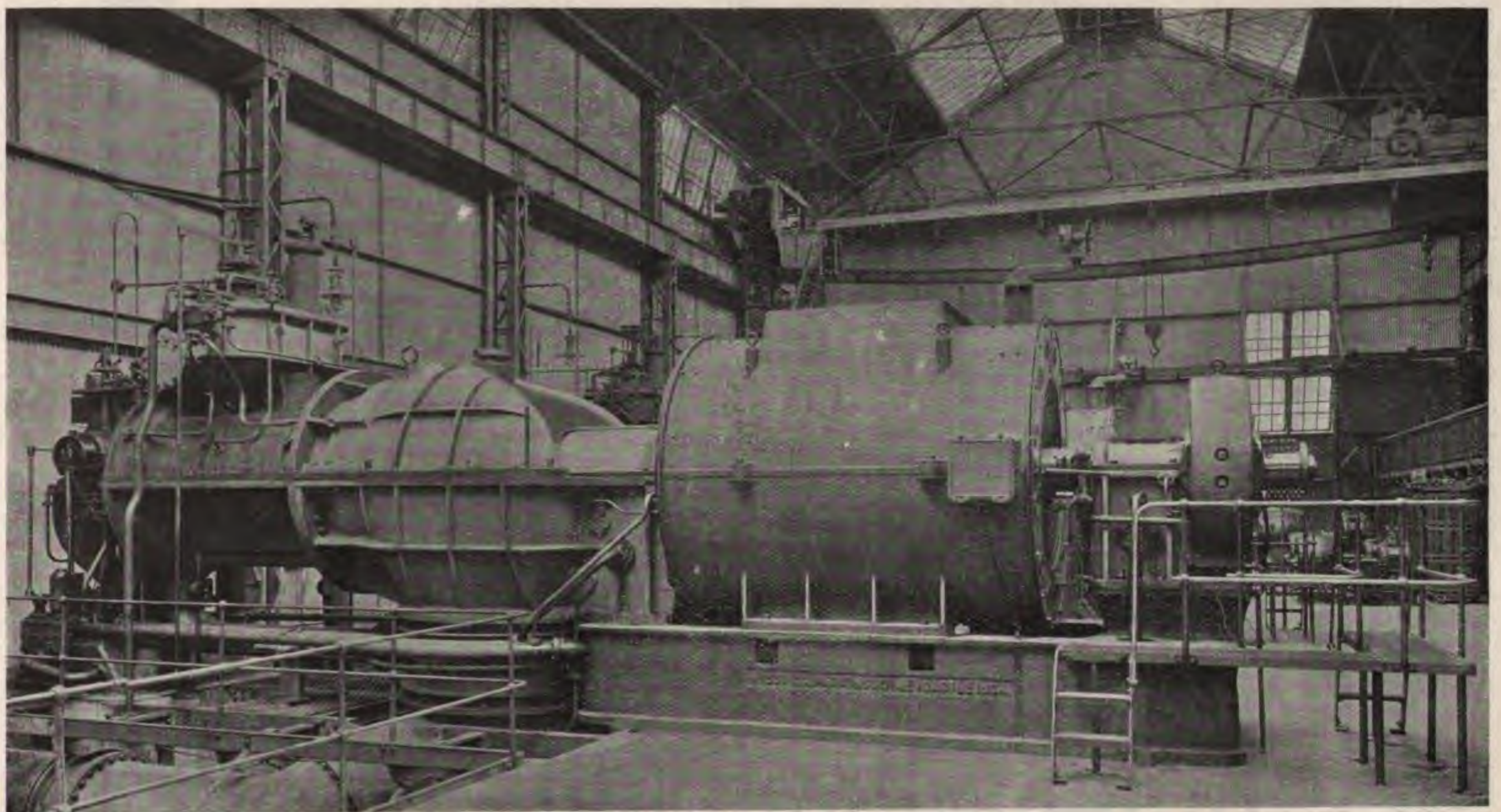
The name of Mr. William Sellers, whose death is reported in our American contemporaries, was a well-known one in transatlantic engineering circles As long since as 1864 he was president of the Franklin Institute, and while acting in that capacity he read a paper on "Screw Threads and Nuts," which has since become the standard for the United States and the form of thread for the continent of Europe.

Mr. Sellers was a trustee of the University of Pennsylvania, a member of the National Academy of Sciences and corresponding member of the Paris Societe d'Encouragement pour l'Industrie Nationale He was also a member of the Institution of Mechanical Engineers, the Institution of Civil Engineers, the Societe d'Encouragement pour L'Industrie Nationale of France, the American Society of Civil Engineers and the American Society of Mechanical Engineers.

Since he assumed the secretaryship of the Chartered Company, Mr. John Frank Jones had become a public official, and in that capacity had displayed abilities of no mean order. Latterly, in addition to his secretarial duties, he become joint manager of the British South African Company, and by his death Rhodesian interests have lost a man who had rendered yeoman service.

Mr. Charles Lockhart, president of the Lockhart Iron and Steel Company, Pittsburg, with plant at McKees Rocks, Pa., and one of the largest stockholders of the American Ax and Tool Company, of New York, whose plant is located at Glassport, Pa., died at his home in Pittsburg on January 26th.

The death of Mr. George Beattie, removes a familiar figure from commercial circles on Tyneside. He commenced his business career with Messrs. James Joicey and Co., and was for many years in later life in business at Tyne Dock. Mr. Beattie was Mayor of South Shields in 1901.



RECENT TURBINE INSTALLATIONS—(1) 5,000 KW. TURBO-ALTERNATOR AT CARVILLE POWER STATION.

Our illustration shows one of the Parsons steam turbo-alternators supplied by Messrs. C. A. Parsons and Co. for the Carville Power Station, of the Newcastle-upon-Tyne Electric Supply Company.

In the 5,000-kilowatt sets all the blades are laced in the high as well as the low-pressure chambers and on both the stator and the rotor. In the case of the low-pressure blades, lacing is effected in the ordinary manner by means of wire at the ends and also half-way down the blade. The lacing of the other blades consists of a ring of metal of the same material as the blades brazed on to the blades. A cross-section of the ring measures ⅛ in. square, and it is brazed for each blade in succession, recesses being cut for this purpose. The alternators are of the revolving field type, directly connected to the rotor shaft of the turbine. At normal speeds they generate three-phase current at 6,000 volts.

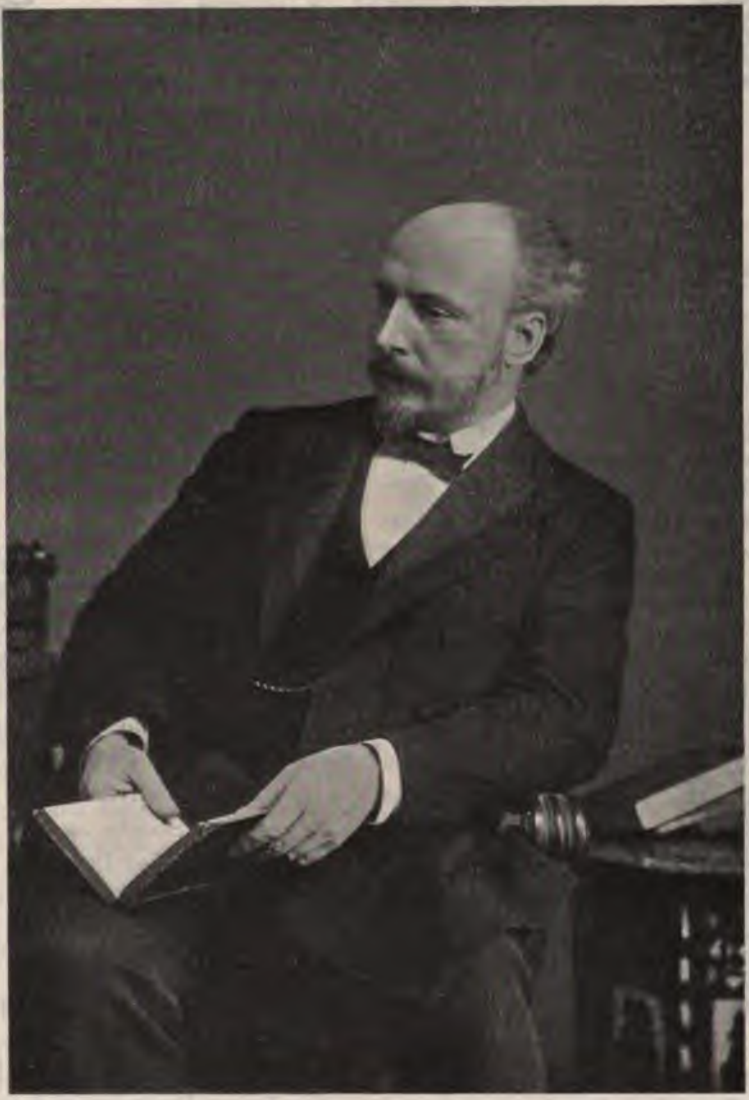


Photo. by Elliott and Fry.]

SIR JAMES DEWAR, F.R.S., M.A., LL.D., D.SC.

OUR WEEKLY BIOGRAPHY.

SIR JAMES DEWAR, F.R.S., M.A., LL.D., D.Sc.

SIR JAMES DEWAR, co-inventor with Sir Frederick Abel of cordite, the smokeless powder used by the British Government, was born at Kincardine-on-Forth, September 20th, 1842. He received his scholastic training at the Dollar Academy and at the Edinburgh University. In 1863 he was appointed assistant to Lord Playfair, who at that period was Professor of Chemistry in the University of Edinburgh. He subsequently completed his studies at Ghent.

The scientific researches carried out by Sir James have won for him an honourable distinction. In 1891, on the occasion of the celebration of the centenary of Faraday's birth, at the Royal Institution, he gave some unique illustrations to demonstrate the peculiarities of liquid oxygen, and he subsequently experimented with a view to ascertaining its behaviour in the magnetic field. He had previously discovered that liquid oxygen did not moisten rock crystal, and, consequently, maintained a perfect spheroidal state when in contact with that substance. Some liquid oxygen, at a temperature of 180 deg. C., was placed in a shallow cup of rock crystal, and brought between the poles of Faraday's electro-magnet. Upon the excitation of the magnet, the whole mass of liquid adhered to the poles, showing that oxygen, which is only feebly magnetic at ordinary temperatures, becomes at 180 deg. C. highly susceptible to magnetism.

In 1894, in recognition of his investigations of the properties of matter at lowest temperatures, he was awarded the Rumford Medal of the Royal Society. In conjunction with Professor Fleming, Sir James carried out researches dealing with the electric and magnetic properties of metals, and other bodies at low temperatures, and several years later, investigations for determining the dielectric constants of bodies at, and above, the temperature of liquid air.

He was elected President of the Chemical Society in 1897, and the next year he succeeded in obtaining 100 cc. of liquid air, thus establishing a fresh basis for further research. The Smithsonian Institution of Washington in 1899 awarded him the first Hodgkin's medal for his discoveries in the liquefaction of air.

In 1901 he delivered the Bakerian lecture to the Royal Society on the "Nadir of Temperature and Allied Problems." The following year he was elected President of the British Association,. The Lavoisier gold medal was granted to Sir James Dewar in 1904, for his researches in liquefaction of gases, and in the same year the Gunning prize was awarded to him by the Royal Society of Edinburgh.

Sir James Dewar is an honorary member of the Institution of Civil Engineers; Professorial Fellow of St. Peter's College, Cambridge; Jacksonian Professor of Experimental Philosophy, Cambridge; Fullerian Professor of Chemistry, at the Royal Institution; and a director of the Davy-Faraday Research Laboratory. He received the honour of knighthood in 1904.

Thermometers and Pyrometers, with some of their Industrial Applications.

BY ROBERT S. WHIPPLE, CAMBRIDGE.

ALTHOUGH we are, perhaps, apt to laugh at the very rough methods adopted by our predecessors for the measurement of temperature, it cannot be denied that accurate temperature measurement is still a problem of considerable difficulty. Temperature is not a measureable quantity in the strict sense of the term. To measure a length or a mass is to count how many times it is necessary to take a given body chosen as a unit (metre or gramme, as the case may be) in order to obtain a system equivalent, either as to length or mass, of the body in question. The possibility of such a measurement assumes the existence of two laws—that of equality, and that of addition. Temperature obeys the first of these laws. Two bodies in temperature equilibrium with a third will also be in equilibrium with each other. The other law is entirely lacking. You cannot by placing together several bodies at one temperature realise a system equivalent from the point of view of exchange of heat, to a body at a different temperature.

GAS THERMOMETERS.

Many scales of temperature have been proposed, but the gas scale is the one now universally adopted, and readings obtained by any type of thermometer—electrical, expansion, or optical—are reduced to temperatures on the gas scale. The gas scale has been adopted as the standard scale of temperature—first, because gas of the same purity can be reproduced at any time; secondly, the dilation of the gas, which defines the scale of temperature, is sufficient for accurate measurement; and, thirdly, the scale is practically identical with the thermodynamic scale.

Although the scale of the gas thermometer has become the standard of reference, yet, fortunately, we are not compelled to use the gas thermometer in everyday life. We do not employ an elaborate gas thermometer (fig. 1), with its adjuncts of telescopes, microscopes, and standard barometer, every time we wish to measure a temperature, but we use a thermometer which has been carefully standardised at certain known temperatures. Thermometers, and with thermometers I include pyrometers, are generally standardised by means of fixed points of fusion and ebullition which have been determined by the gas thermometer.

The illustration is taken from "La Convention du Mètre et la Bureau International des Poids et Mesures," p. 50, by Dr. Ch. Guillaume, and shows the small gas thermometer at the Bureau International des Poids et Mesures, Paris.

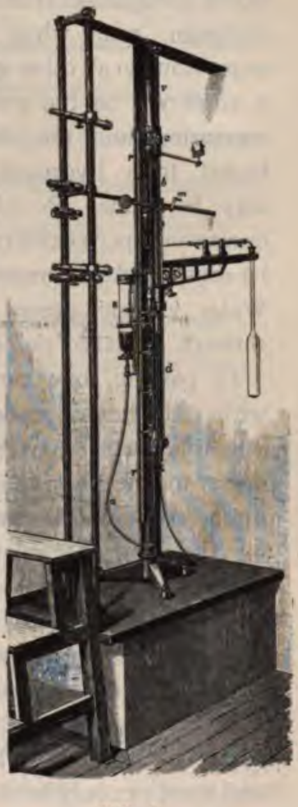


FIG. 1.

It is, perhaps, for this very reason that many of the discrepancies in high temperature thermometry have arisen. The actual precision of high temperature measurements depend on the accuracy to which these fixed points are known. It has at present been found impossible to determine many of these directly on the gas thermometer, as even the platinum-iridium bulb of the gas thermometer becomes porous at extremely high temperatures. High temperature thermometry is badly handicapped through the scarcity of materials capable of being made into a thermometer bulb and of standing high temperatures. Platinum—the great stand-by—has been shown by Sainte-Claire-Deville and others, to be very permeable to hydrogen—a gas which is generally present where combustion is incomplete. Fortunately, platinum, even when red-hot, is practically impervious to all other gases ; so that if nitrogen is employed as the gas whose volume we are measuring, and the platinum is suitably protected from hydrogen, accurate observation may be made. Porcelain must be glazed to ensure non-permeability, and the glaze cannot be considered impermeable above 1,100 deg. C. Water vapour passes comparatively rapidly through unglazed porcelain.

In passing, one cannot help being struck with the interdependence of all branches of scientific work. At first thoughts it would not occur to one that the accurate determination of the value of the metre would be the means of producing the most accurate thermometry the world has seen ; yet so it has been. To determine the length of a standard bar it is essential that its temperature should be known accurately; to measure the temperature accurately the constants of the thermometer employed must be known to a high degree of precision, and these can only be obtained from an elaborate system of comparators, gas thermometers, etc. Thus the preliminary work on the measurement of the metre produced the masterly work of Dr. Ch. Guillaume on the mercury thermometer and his valuable treatise "Thermométrie de Précision."

I cannot here enter into the details of the construction and working of a gas-thermometer, and would refer those who are specially interested to Dr. Guillaume's book previously mentioned, or to Dr. Burgess's translation of M. Le Chatelier's book, "High Temperature Measurements." I must acknowledge my indebtedness to the latter book for some of the facts mentioned in this article.

TYPES OF THERMOMETERS.

As previously stated, the gas-thermometer, although invaluable from the strictly scientific point of view, is practically useless as a tool in everyday life. It will be well, therefore, to summarise roughly the various means of measuring temperature in general use, and to then treat these methods more fully in detail with their particular applications.

TYPES OF THERMOMETERS IN GENERAL USE.

—		Type.	Range in Deg. Cent. over which they can be used.
Expansion.	Those depending on the change in volume or length of a body with temperature.	Gas Flow of air Mercury (Jena glass and nitrogen) Spirit Unequal expansion of metal rods. Contraction of porcelain.	0° to 1000° 0° to 1600° – 40 to 500 – 100 to + 40 0° to 500° 0° to 1800°
Thermo-electric.	Those depending on the electromotive force developed by the difference in temperature of two similar thermo-electric junctions opposed to one another.	Galvanometric Potentiometric.	0° to 1600° 0° to 1600°
Electric Resistance.	Those utilising the increase in electric resistance of a wire with temperature.	Direct reading on Indicator Bridge and galvanometer	0° to 1400° 0° to 1400°
Radiation.	Those depending on the heat radiated by hot bodies.	Radio-micrometer Bolometer	0° to 10,000° 0° to 10,000°
Optical.	Those utilising the change in the brightness or in the wave-length of the light emitted by an incandescent body.	Incandescent filament in telescope Nicol with quartz plate and analyser.	0° to 2000° 0° to 2000°
Calorimetric.	Those depending on the specific heat of a body raised to a high temperature.	Copper or platinum ball with water vessel.	0° to 1500°
Fusion.	Those depending on the unequal fusibility of various metals or earthenware blocks of varied composition.	Alloys of various fusibilities.	0° to 1980°

Dr. Chree, in some valuable Notes on Thermometry, published in the Philosophical Magazine for March, 1898, makes the statement that "the ideal mercury thermometer is one which accommodates itself at once and completely to the temperature it is for the time being exposed to, and which, when exposed to a given temperature, supplies an invariable reading." I think there could not be a better definition of what is required from any form of thermometer.

EXPANSION THERMOMETERS.

Although the gas thermometer is essentially an expansion instrument, we will pass at once to the mercury in glass thermometer as being the expansion instrument par excellence. Many of us know how far the mercury thermometer, as generally used, falls short of Dr. Chree's ideal, but I think few of us realise how near Dr. Guillaume has brought us to that ideal. It is now possible, thanks to his work, to measure temperature with a mercury thermometer, with an accuracy of 0·001 deg. C.

It is sad to think how far we in England have been behind French and German practice in the construction of accurate mercury thermometers; more especially when it is borne in mind that Kew standards, as made under the direction of Balfour Stewart and Welsh, were for many years the standards of the world. I can only account for it by the fact that we were standing still whilst the National Physical Laboratories of France and Germany were developing the construction and materials of their thermometers. With our own National Physical Laboratory, now well established under the able direction of Dr. Glazebrook, we are not likely to fall behind again. We will now consider briefly the various errors found in a mercury thermometer of the best construction, and the methods of determining the corrections to allow for them.

Fig. 2 illustrates a collection of standard mercury thermometers as designed by the Bureau International des Poids et Mesures.

CORRECTION FOR PARALLAX AND REFRACTION IN MERCURY THERMOMETERS.

The divisions of the scale on the stem of a thermometer are not exactly adjacent to the mercury thread, and consequently the readings will vary somewhat with the direction of the line of sight. This error is best eliminated by taking the mean of the readings when the scale is on the side nearest the observer, and again when placed opposite. Unfortunately, this necessitates doing away with the enamel back in the case of very accurate thermometers.

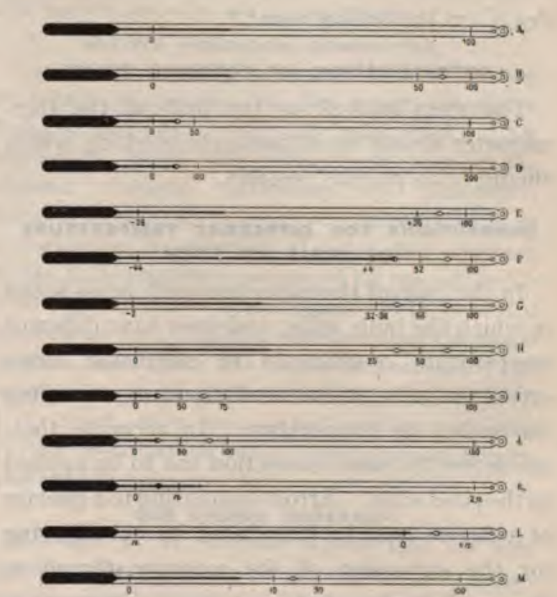


FIG. 2.

SCALE AND CALIBRATION CORRECTIONS.

It is impossible to obtain a tube or stem of absolutey uniform bore. It follows, therefore, that the size of a degree division must vary throughout the tube. The error arising from this inequality in the bore can be accurately determined by measuring the length of a small thread of mercury in scale divisions in various portions of the stem.

DETERMINATION OF BOILING POINT.

Care must be taken in the determination of this point, the whole thermometer being enveloped in steam, which is allowed to pass freely into the open air. It is important that the barometer reading should be determined accurately, a difference of ·14 millimetre in height of the barometer making a difference of 0·005 deg. C. in the boiling point.*

DETERMINATION OF FREEZING POINT.

The stem as well as the bulb of the thermometer should be in finely-chopped ice, which should be as pure as possible.

CORRECTIONS FOR DIFFERENT TEMPERATURE OF SCALE OR STEM.

In the case of thermometers with brass scales in which the bulb, scale, and stem have different temperature co-efficients of expansion, large errors may be introduced by not correcting the scales for temperature. In accurate thermometers the same correction has to be applied to the glass scale. Errors amounting to a quarter of a degree may be introduced by not allowing for the expansion of the mercury thread in the capillary bore.†

CORRECTION FOR PRESSURE ON THE BULB.

There is an external and internal pressure of the thin glass of the bulb. At high elevations above sea level, when the atmospheric pressure is reduced, the error introduced becomes of importance; but for general use it may be neglected.

In long-stem thermometers the error introduced by using horizontally a thermometer which has been calibrated vertically, becomes of importance. I once examined a mercury thermometer about 9 ft. long, in which the error introduced by using the thermometer horizontally amounted to 30 deg.

An expansion thermometer of general interest is the one in which temperature is measured by the unequal expansion of two materials, such as steel and porcelain or graphite. A graphite rod is placed at the bottom of a closed steel tube, a small steel tube being connected to the upper end of the graphite rod. By means of various simple mechanical movements the differential expansion of the two rods is indicated on a dial. These thermometers are useful up to temperatures of about 1,200 deg. F. The corrections to two of these graphite thermometers are plotted in fig. 3, the temperature when they become unreliable being clearly shown.

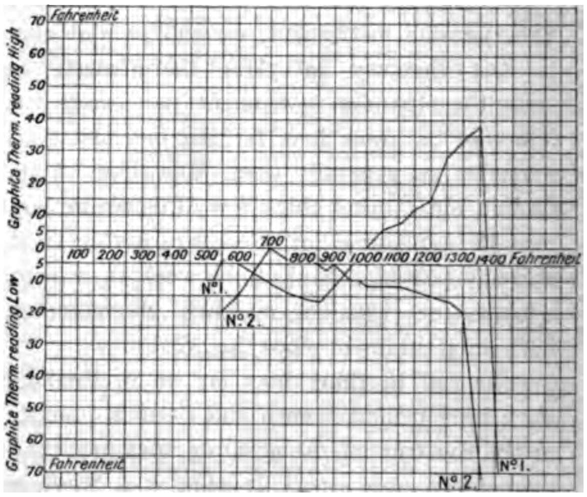


FIG. 3. RESULTS OF TESTS OF TWO GRAPHITE THERMOMETERS.

The Uhling pyrometer always impresses me as being one of the most ingenious yet constructed. Knowing as I do something of the difficulties that a new invention entails, I feel that Mr. Uhling must be warmly congratulated on the ingenuity expended in developing his idea and on the success obtained by his pyrometer. As I have had no practical experience with this pyrometer, however, I do not like to discuss it in detail.

(To be continued.)

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* Wiss Abhandl. der Phys.-Tech. Reichsanstalt, Vol. I., p. 102.

† Modern Meteorology, F. Waldo, 1893, p. 42.

A paper read before the Cleveland Institution of Engineers, Middlesbrough.

THE INSTITUTION OF MECHANICAL ENGINEERS.

PROGRESS AND WORK DURING 1904.

At the annual meeting of the above Institution this evening a very satisfactory report dealing with the work accomplished during the past year will be presented. The following is an abstract :—

MEMBERSHIP ROLL.

The total number on the roll of the Institution at the end of 1904 was 4,477, which, as compared with 4,211 at the end of the previous year, shows a net gain of 266. During the past year 460 candidates were elected, of whom 47 were formerly graduates, and two elections became void, thus making 411 names added to the register. The total deductions have been 145, made up of 50 deceases during 1903, 59 resignations which took effect on January 1st, 1904, and 36 removals.

FIFTY-FOUR DECEASES.

Fifty-four deceases of members were reported during 1904, including Sir Lowthian Bell, elected 1858; Mr. F. Rouse, Peterborough, elected 1856; Mr. J. W. Bower, Leamington Spa, elected 1858; Mr. J. B. Howell, Sheffield, elected 1861: Mr. A. Fry, Bristol (deceased, 1903); Mr. C. J. Galloway, Manchester, and Mr. T. Holcroft, Bilstow, elected in 1866. The Council place on record their great regret at the loss of H.R.H. the Duke of Cambridge, who became an honorary member in 1892.

REVENUE.

The total revenue for the year 1904 was £11,049 10s. 2d, while the expenditure was £10,406 0s. 8d., leaving a balance of revenue over expenditure of £643 9s. 6d., exclusive of entrance fees £472 and life compositions £139 carried direct to capital account, and exclusive of the value of subscriptions in arrear. The financial position of the Institution at the end of the year as shown by the balance-sheet: The total investments and other assets amount to £72,175 0s. 3d., and, deducting therefrom the £25,000 of debentures and the total remaining liabilities, £2,018 15s. 5d., the capital of the Institution amounts to £45,156 4s. 10d.

STEAM ENGINE RESEARCH.

The first report by Professor David S. Capper, to the Steam-Engine Research Committee, of which Mr. William H. Maw is chairman, has now been completed, and, together with a preliminary report on progressive speed and pressure trials carried out previous to March, 1896, will be presented at the March meeting. The question as to whether this research should be continued, and in what direction will be considered after the discussion on the present report.

ALLOYS RESEARCH COMMITTEE.

Since the presentation in January, 1904, of the late Sir William Roberts-Austen's last report, the Alloys Research Committee, under the chairmanship of Sir William H. White, has continued its work at the National Physical Laboratory. Dr. Glazebrook, Director of the Laboratory, has arranged a series of investigations on specimens of nickel steel presented by Mr. R. A. Hadfield, a member of the committee. It is anticipated that a further report will be presented this year by the Committee, communicating the results of these researches. The names of Professor J. O. Arnold, Dr. A. Barr, Mr. F. W. Harbord, and Mr. J. E. Stead, have been added to the committee. Further investigations having great practical importance are now being considered.

GAS ENGINE RESEARCH.

Professor F. W. Burstall reports that the two specially constructed large gas-engines and a gas holder erected in the new power house of the Birmingham University are now available for the Gas-Engine Research Committee's experiments. A scheme of experiments, indicating the methods of working, is under consideration, and it is hoped that the next report will be ready for presentation at the opening of next session. A generous gift of £100 towards the expenses of carrying on the research has been received from Dr. Ludwig Mond, F.R.S. The name of Captain H. Riall Sankey has been added to the committee, of which Dr. A. B. W. Kennedy is chairman.

INITIAL CONDENSATION IN STEAM CYLINDERS.

The experiments on initial condensation in steam cylinders, which Professor T. Hudson Beare, reporter to the Committee on the Value of the Steam Jacket, is carrying out with special apparatus for the purpose, are in active progress, but are still incomplete. The results obtained so far, however, justify the hope that the Committee, under the chairmanship of Mr. Henry Davey, will be able to present, during the year 1905, an interim report dealing with the results obtained in the experiments on non-jacketed cylinders.

THE SUMMER MEETING.

It is intended to hold the next Summer Meeting in Belgium, in view of the International Exhibition to be held at Liége in 1905.

NAVAL NOTES

WEEKLY NOTES ON NAVAL PROGRESS IN CONSTRUCTION AND ARMAMENT.

(BY OUR NAVAL CORRESPONDENT.)

GREAT BRITAIN.

THE past week has been a busy one in commissionings for the British Navy, the *King Edward VII.*, the *Sapphire*, and the *Diamond* having all hoisted the pennant for the first time. The *King Edward VII.* becomes flagship of Vice-Admiral (acting) Sir William May, who takes over command of the Atlantic Fleet on March 1st, from Lord Charles Beresford. The *Sapphire* is the flagship of Rear-Admiral Winsloe, commanding the torpedo craft and submarine flotillas *vice* the *Halcyon*, and the *Diamond* has gone to the North American station.

The repairing vessels *Erebus* and *Fisgard*, which were but recently allocated to the services of the Portland and Harwich destroyers have now been withdrawn from those duties and are to be employed for the instruction of boy artificiers. Considerable changes are indeed in course of evolution in regard to the destroyer flotillas and the sea-going depot ships attached to each flotilla. These changes are complementary to the redistribution scheme of last December and like that scheme will result in increasing the war-readiness of the fleet.

The scout *Skirmisher* was launched at Barrow, on February 7th and two more submarines of the A class took the water on the 9th at the same yard.

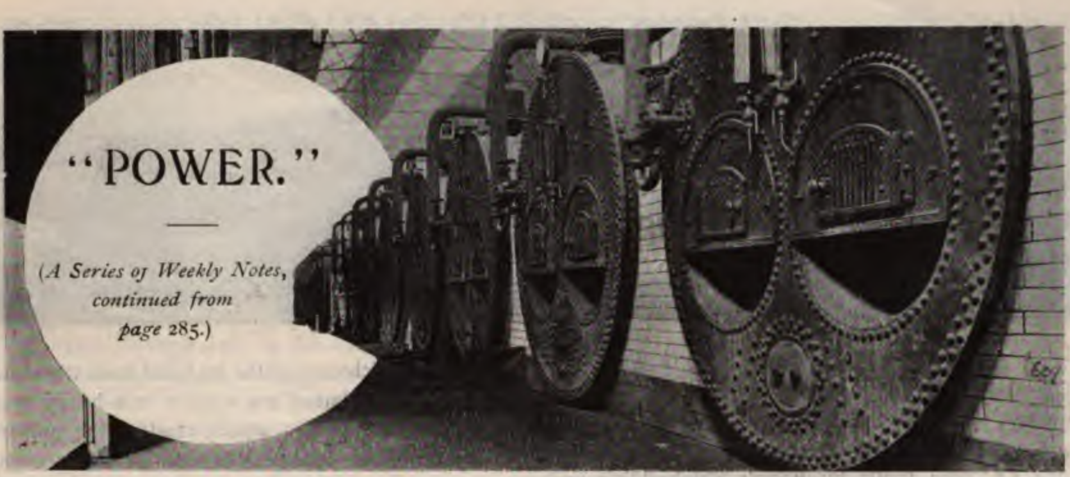
The cruise of the ships in commission in reserve at Devonport, under command of Read-Admiral C. S. Robinson, this week is a remarkable proof of the thoroughness which has characterised the new scheme of distribution and mobilisation. Up to the beginning of last month the vessels composing this squadron, with one or two exceptions, were laid up in the basins, and were only kept in working order by occasional visits from small bodies of dockyard workmen, who would not of course have formed part of the crew had the vessels been commissioned hastily for service in an emergency. Now, however, the vessels are continually manned by all the more expert ratings, a fair proportion of their officers live on board, and the result is that the vessels are fit to take the sea and offer battle with a few hours' notice from the Admiralty to bring their complements up to full strength. Those who remember the breakdowns and discomforts incidental to the commissioning of reserve ships for the manœuvres in past years will realise the enormous gain to the Fleet in battle-worthiness by the new arrangement.

GERMANY.

The total of the German Navy estimates for 1905 is £11,610,000 (M. 232,200,000). This includes a vote for construction which is subdivided to allow for the completion of the battleships *Hessen* and *Preussen*, the armoured cruiser *York*, and the small cruisers *Munchen* and *Lubeck*, and for the commencement of the two battleships *Q* and *R*, of the *Deutschland* class, the armoured cruiser *D*, the small cruisers *O*, *Ersatz Wacht*, and *Ersatz Blitz*, and two gunboats. There is a charge of a million and a half marks for submarines to be purchased. The personnel is to be increased by one hundred officers, including one vice-admiral, two rear admirals, and four captains.

UNITED STATES.

The contracts for the armour plate for the new American vessels have been awarded to the Carnegie and Bethlehem Companies. Although the Midvale Company, which secured last year's contract made a lower bid than the two other companies, it was not judged expedient to give more work to the new firm until it has demonstrated its ability to carry through the work already in hand.



"POWER."

(A Series of Weekly Notes, continued from page 285.)

In an experiment with a cubical metal box, internally heated and submerged in water, it was found that steam was generated from its upper surface more than twice as fast per unit of area than from its vertical sides and that the bottom surface generated no steam at all. These differences are owing to the difficulty with which steam separates from a vertical surface to give place to fresh charges of water, and to the impossibility of its escape from an inverted surface.

The box was also placed in an inclined position, when the elevated side permitted the steam to escape much more readily, and the rate of evaporation was increased; while on the depressed side the steam hung so sluggishly as to cause the metal to become overheated. It appears from this that in locomotive boilers the sides of the firebox should be inclined for the better escape of the steam bubbles upwards.

It is thus evident that in any steam boiler there are various qualities of heating surface, and that when we say of a boiler that it contains so many square feet of surface, we are speaking of a total whose constituent parts differ enormously in efficiency. For example, in locomotive, or in loco-type, boilers—for there is a distinction between these terms about which we shall have something to say presently, there is no doubt that the firebox heating surface, so far as steam-making is concerned, is worth all the rest put together. The first twelve inches of tube surface, again, makes more steam than all the remainder of the tube length, and so on, very nearly, the last portion of tube surface being of little actual value. Thus we might have two locomotive boilers with the same tube surface, yet of vastly different steaming powers. If we have two boilers, one with 1,000 square feet of tube surface, the tubes being 7 ft. 6 in. long, and another with 2,000 ft. of tube surface, with 15 ft. tubes, other conditions being equal, the steaming power of the last-named boiler will not be 10 per cent. better than that of the former. But if we double the number of the 7 ft. 6 in. tubes, instead of doubling their length, then, indeed, if the products of combustion be sufficient to fill and traverse the tubes, the power of the boiler will be nearly doubled, because the number of first feet of tube is doubled. Of course, the tube-length in a locomotive-engine boiler is a function of the general design of the engine, and the boiler, both in length and diameter of barrel is limited by structural considerations, which have nothing to do with steam making.

Again, long tubes require a sharper blast than short ones to maintain the draught, because there is more frictional resistance; directly, as the increase in length of tube, and indirectly because the long tube fouls, or becomes coated with soot more rapidly than a short one. Under certain conditions, as when the boiler is forced, heavily fired, with a strong blast, the velocity with which the gases are drawn through the tube may have the effect of making the second foot in length nearly equal to the first in value. The true measure of the boiler power is the grate area; and now, after many years of "piloting," or in effect doubling the grate area by the expedient of hitching on a second engine, we have passed into the era of gigantic boilers, limited, apparently, in diameter, only by the loading gauge, with such marked success, that the only wonder is that we have stuck so long to the idea that any amount of tube surface would make up for deficient firebox and grate area.

Shipbuilding Notes.

A STEAMER IN SECTIONS FOR PERU.

The steamer *Grange Branch* sailed from Hull on Saturday, January 28th, for Mollendo, South America, with the entire hull, machinery, and outfit of the s.s. *Inca* (built by Earle's Shipbuilding and Engineering Company, Ltd., Hull), which is intended for service on Lake Titicaca, situated high amongst the mountains of Peru.

There is nothing new in the construction and shipment of small vessels in pieces for re-erection in foreign parts, but not often has work of this description been carried out on such a large scale.

The *Inca* will carry about 550 tons dead-weight. Her dimensions are 226 ft. by 30 ft. by 14 ft., and she is propelled by twin screw engines of 1,000 h.p., and will have a speed of 12 knots.

The fact that the whole of the work has had to be erected and then taken to pieces has necessarily involved special precautions being adopted to ensure the shape of the structure being maintained up to the point of taking down. The saloons, staterooms, pantries, etc., were all built up in the joiners' shop, a portion of this building having been prepared to represent the dock of the vessel, and this section of the work was completed in practically all its details, including upholstery, curtains, rods, dining tables, etc., as well as an installation of steam heating. The leads of wires for the electric light, position of switches, and all other details were marked on the cabin sides. The auxiliary machinery, fans for forced draught, with pipes and connections were all fitted up on the ship.

In addition to the structural portions and fixed parts of the internal arrangements, the materials include a variety of incidental fittings, such as bolts, nuts, rivets, screws, etc. There were over three thousand separate packages, each of which required a separate mark of identification for those who will have to undertake the re-erection; there are also separate marks for shipment purposes.

The question of transport is not by any means an easy one at the port of Mollendo. The barges or lighters which convey the material from the steamer in the open roadstead are subject to a heavy ground swell from the Pacific, which renders the unloading an operation of considerable risk to those engaged in the work. From the port, to the site of re-erection on Lake Titicaca, which is situated between the ranges of the Andes, the sections, etc., have to be conveyed by rail a distance of about 150 miles. The railway which runs along the mountain sides and across valleys, is a remarkable work of engineering, and rises in the 150 miles to an altitude of over 12,000 feet.

The site of erection is also interesting, and it is said represents the cradle of the ancient Inca races. Norwithstanding the novelty of construction, which caused large portions of the ship to be left in a very incomplete condition owing to the absence of fastenings, and also to the risk of taking to pieces such an intricate structure, the whole of the work was carried out practically without accident to those engaged.

LAUNCHES.

Messrs. Archibald McMillan and Son, Ltd., shipbuilders, of Dumbarton, have just launched the steel screw steamer *Osprey*, built to the order of Mr. Hugh Flinn, of Liverpool. The dimensions are as follows: Length between perpendiculars, 140 ft., breadth, 23 ft. 6 in., depth, 10 ft. 9 in. The vessel is designed to carry a deadweight of 360 tons, and is fitted with raised quarter deck and topgallant forecastle. Machinery for a speed of ten knots is being supplied by Messrs. McKie and Baxter, Glasgow. The vessel and machinery have been built to Lloyd's highest class, and under the superintendence of Mr. A. J. Maginnis, of Liverpool. The christening ceremony was performed by Miss Flinn, daughter of the owner.

H.M.S. *Kennet* is the first vessel to be completed by the Thorneycroft Company at their Woolston Works, Southampton. She is 225 ft. in length, by 23 ft. 10½ in. beam, with extreme draft of 9 ft. 6 in., and a normal displacement of about 580 tons.

RUNNING-SHED NOTES.

III.—BY J. C. R. ADAMS.

There is another kind of brake with which some engines are fitted, all unsuspectingly by the makers, but which nevertheless exercises a considerable effect in absorbing power. I mean the piston rings. The construction of the piston rings is too large a question to enter upon here, but the ill-effects of a tightly-fitting spring plug which has to be driven by the unfortunate engine through four or five hnndred feet of cylinder per minute may be easily imagined.

If there is reason to suspect a piston of being too tight, it may be put to the proof by laying the hand upon the connecting-rod after the steam has been shut off, and while the engine is still revolving by the momentum of the flywheel. The lag or drag of the piston will then be distinctly felt at each end of the stroke. This is also the best time for detecting slack connecting-rod brasses, as, owing to there being no compression or cushioning action of the steam the reversal of motion in the reciprocating parts gives both audible and tangible evidence of any lost motion in their joints. Conversely, the instant of starting is the psychological moment for testing the touch by adjustment of the main or crank-shaft bearings.

We now come to the testing of the slide valves and pistons, both for adjustment, and for steam-tightness. In single slide-valve engines, whether with one or two cylinders, if the slide valves and cylinder faces are accurately made to dimensions, the valves can be set by observing the "beats" of the exhaust steam, with a sufficient approximation to accuracy. For instance, if the exhaust beat sounds heaviest when the cross head is at its furthest from the cylinder, then there is too much steam admitted at the back end of the cylinder, and the valve rod must be adjusted by slightly lengthening, by whatever means of adjustment are provided. If too much steam be admitted at the front end, then the valve rod is too long and must be shortened. A driver, with a well-attuned ear can set a valve in a minute or two in this way, so that an indicator diagram taken afterwards will show an almost exact balancing of the two sides of the piston.

If there is an expansion valve working on the back of the main slide valve, and no indicator is at hand, the valves may be adjusted—provided the eccentrics are properly placed—by temporarily removing the expansion-valve, and setting the main slide "by the lead," that is adjusting the main valve-rod for length by observing the positions of the valve when the crank is on the dead centres, and equalising the openings for each end of the cylinder. The expansion valve being then put in place, and the cover put on the steam chest, the engine may be started and the expansion valve set "by ear" as above described. But in the running shed, the indicator is always used in valve-setting, if there is anything beyond a plain slide-valve to be dealt with.

To test the steam-tightness of the valves and pistons, which should not be done until the engine has been running for a few hours, in order to allow them to "come up to a face"—we may proceed as follows: Set the crank on each of the dead centres successively (in a single-cylinder engine), and turn the steam on suddenly. If the exhaust nozzle is accessible, and no steam is seen to escape with the crank on either dead centre, it may be taken for granted that both slide valve and piston are tight. Should steam appear, a valve leakage may be distinguished from a blowing piston, by turning the crank round until the cut-off point is passed, in which position the slide valve will entirely cover the steam ports. If no steam passes now, the leakage may be confidently ascribed to the piston. Many slide valves, from their form have a tendency to "buckle" or arch themselves, when hot, so that a valve which is a perfect fit all over its surface, when cold, will bear only upon the two ends when heated up to its working temperature. So well is this understood that it is a common practice to allow, for it in surfacing the valve, by scraping the ends so that they do not touch the surface-place, when cold.

In a double cylinder engine, if fitted with reversible eccentric sheaves, the simplest way of testing the valves and pistons is to set one of the valve eccentrics "to run backwards." The engine is then "hove to," as a sailor would say, and can neither turn one way nor the other, in which condition it is of course, perfectly tractable, and may be placed in almost any required position for valve testing and observation.

In a compound engine the high-pressure piston and valves may be tested by the pressure-gauge on the receiver, if one be fitted, which will show at once if pressure is accummulating in the low-pressure valve chest through leakage in the high-pressure valves or piston. The low-pressure side in its turn may be set on its dead centres, and steam admitted direct by the by-pass valve to the low-pressure steam chest, from which it will escape through the exhaust pipe to the atmosphere, in case of leakage through valve or piston.

ELECTRIC POWER IN COLLIERIES.

At the last meeting of the Rugby Engineering Society, on February 2nd, Mr. G. M. Brown, B.Sc., read a paper on this subject. The following is an abstract of the main features of the paper :—

The greatest advance in the application of electricity for mining purposes has been due to the introduction of the polyphase alternating current induction motor. One of the chief advantages of alternating current plant for mining work lies, of course, in the fact that all the switches can be of the oil-break type, and the use of fuses is not necessary. The author is not aware that the results of any experiments on the behaviour of this type of switch, when used with direct current, have yet been published. When used on alternating current circuits, they will operate perfectly under the most trying conditions ; but when used on direct current circuits, there is considerable carbonisation of the oil every time the circuit is opened with a heavy current. This is no doubt due to the fact that on alternating current circuits there is no electrolytic action, and any arc formed between the switch-blade and contacts is extinguished at the instant when the current passes through zero, whereas when used on a direct current circuit, the full amount of energy which can be stored in the circuit is to be dissipated in the switch.

TYPES OF GENERATING PLANT.

With regard to the generating plant which must be installed, unless power is to be taken from the mains of a supply company, it is necessary to decide the voltage and periodicity which will best meet the circumstances of the case, for the nature of the current is practically decided by consideration of the relative advantages and efficiencies of two-phase and three phase induction motors. Thanks to the labours of the recent commission on the standardisation of electrical machinery, there are practically only two periodicities to consider, viz., 25 and 50 complete cycles per second.

VOLTAGE AND PERIODICITY.

With regard to both voltage and periodicity, it is impossible to lay down any definite rules, and a conclusion can only be arrived at after careful consideration of the case in hand. In general, when there are a large number of slow speed motors of high power, say for driving reciprocating pumps, and large haulage gears, or main winding gear, it will be desirable to select 25 cycles and voltage according to amount of power and distance it has to be transmitted, for large 25 cycle motors have better constants that 50 cycle motors. If, on the other hand, there is much pumping to do, and it is decided to use high-lift centrifugal pumps, which require motors running at high speeds, it will be more satisfactory to select 50 cycles. If the plant is small, and there are no very large motors, 50 cycles will be the better periodicity, and will allow of both arc and incandescent lighting as well as much greater choice of speeds for the motors.

The voltage to be selected depends not so much on the size of the motors as on the amount of power to be transmitted to various points, and their distance from the generating station. In ordinary cases where the generating plant is situated close to the mouth of the shaft, and most of the power is required near the bottom of the shaft, it will be advisable to fix on 500–550 volts as the most economical.

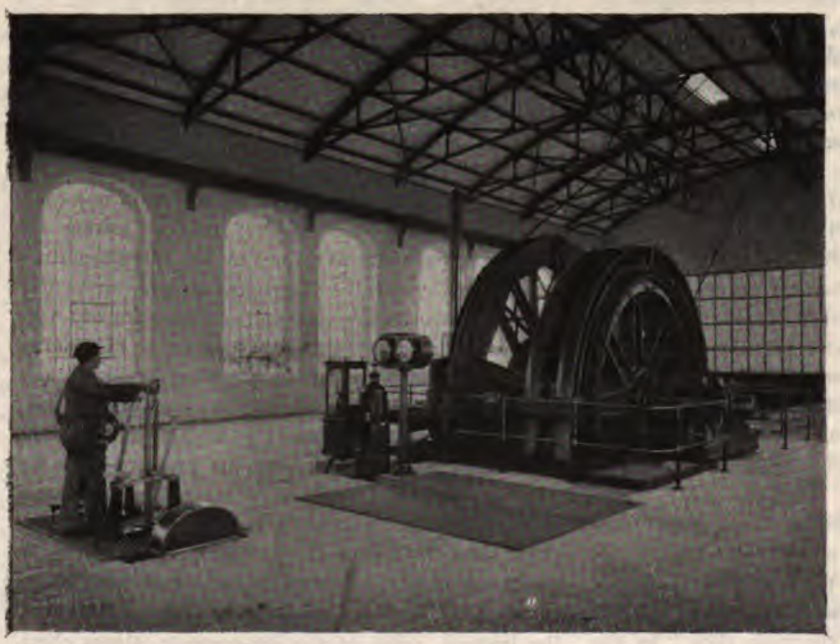


FIG. I.—ELECTRIC WINDING ENGINE, PREUSSEN PIT II.

ELECTRICAL WINDING GEARS.

At present there are no very large winding gears electrically driven in this country, and although a great many have been installed on the Continent, there are none of the capacity of some of the steam winding engines at our larger British collieries, a condition of affairs which has caused some mining engineers to conclude that it is impossible to wind as much coal from a shaft in a given time electrically as by steam power. On investigating the problem, it would, however, appear that the difficulties are of such a character that they are likely to be overcome in the immediate future.

A good example of this type of plant is that installed at the Zeche Matthias Stinnes, Carnap, Westphalia, which is capable of dealing with 100 tons per hour and winds from a depth of 437 fathoms. The winding gear is driven by two motors directly coupled to Koepe pulley, 19 ft. 8 in. diameter, running at forty-one revolutions per minute. In the case of large winding gears connected to a power station, situated very near the shaft, the most promising and most economical plan seems to be the installation of a separate engine and dynamo for supplying current to the winding gear motors. In this country winding engines have occasionally to deal with 250 tons per hour from depths up to 800 fathoms. Figs. 1 and 2 illustrate a winding engine plant at the Preussen Collieries, Westphalia.

PUMPS IN MINES.

One of the principal applications for electricity in mines is to the driving of pumps. At the present time it is possible to obtain reciprocating pumps of the Express, or high-speed type, having very much higher efficiencies and running at such speeds that reduction gearing may be dispensed with, and the motor mounted directly on the crank shaft. The speeds of such pumps range from 160 to 300 revolutions per minute, and their efficiencies may be from 75 per cent. to 85 per cent., according to size, the latter figure referring, of course, to the largest size. One of the most notable installations is that of the Zeche Viktor, where there are two pumps on the lower level which deliver 1,500 gal. per minute to a height of 1,700 ft. The guaranteed combined efficiency is 58 per cent., but from actual tests the efficiency of the whole plant, including generators, is 63 per cent., and the efficiency of the pumps alone 77 per cent.

A general meeting of the Mining Institute of Scotland was held on February 8th, at Glasgow. During the afternoon of that day a large number of the members visited the works of Messrs. Mavor and Coulson, Ltd., Mile End, Glasgow, where there was a demonstration of electrical coal cutting appliances.

At the evening meeting Mr. E. O. Forster Brown contributed a paper on "The Application of Electrica Power at Mines in Germany." He said that Westphalial had of late made the greatest strides in experimenting with and applying electricity in various ways for mining purposes, although the natural conditions prevailing there appeared to be scarcely so favourable for its adoption as in Silesia. The system of current used for general purposes at all of the newer plants with rare exceptions, was three-phase. The purpose to which electricity was chiefly applied were, in relative importance, as follows: Pumping, ventilation, winding, hauling, coal-cutting and air-compressing. The author gave a description of the electric installations at the principal German collieries.

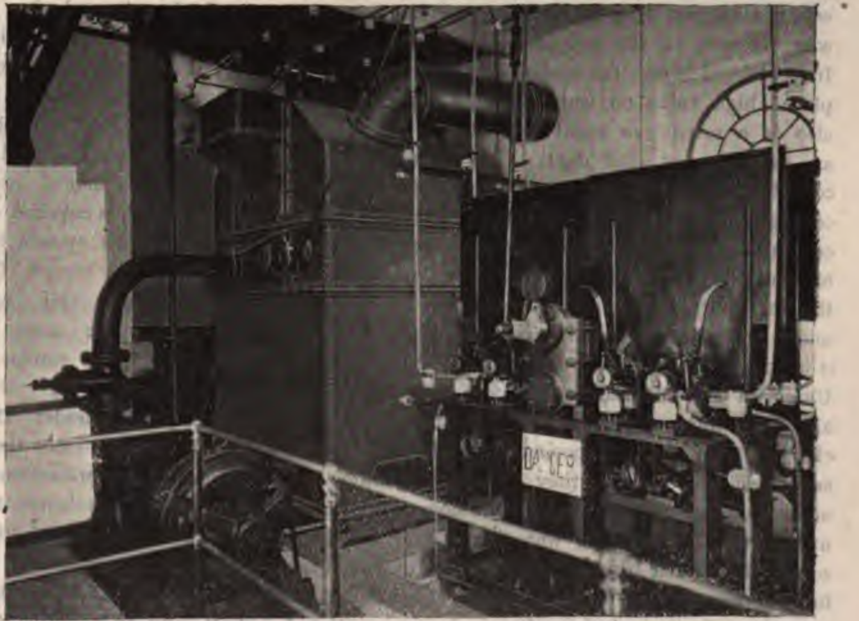


FIG. 2.—CONTROLLER AND SWITCHGEAR FOR WINDING ENGINE, PREUSSEN PIT II.

COAL MINING PROBLEMS.

At the last meeting of the North of England Institute of Mining and Mechanical Engineers, Mr. W. C. Blackett presiding, Mr. E. H. Robertson read a paper on "The action, influence and control of the roof in Longwall Working." The author said that this subject embraced such problems as the protection of miners at the coal-face, of putters and ponies in the gateways from accidents caused by falls of stone, and, on a more comprehensive scale, the laying out of the workings in such a way as to ensure the upkeep of airways and waterways in the waste at the least possible trouble and expense, and to prevent the coal being unduly crushed as the weight of the roof comes on, while at the same time utilising the roof weight to assist the hewers at the face in the working of the coal. The methods by which these problems were to be solved differed greatly, being dependent on the relative hardness of the coal, the roof, and the floor, and on the depth, thickness and inclination of the seam. The writer gives examples of longwall working in six seams under these various conditions, and states that the principal factor in ensuring a safe and gradual subsidence of the roof of a longwall gateway is careful packing. Generally speaking the roof has little influence on the coal in working to the dip as compared with that when working to the rise.

"Water-sprayed or damped air in Coal Mines," was the subject of a paper by Mr. James Ashworth, who referred to the opinions of several of H.M. Inspectors of Mines, the majority of whom apparently placed high value on watering as a preventive and also as a restrictive agent against the extension of an explosion of coal dust. The paper goes into considerable detail as to temperatures and percentages of saturation. Reference is made to the continual presence of fine dust (due to the transit of coal) floating in the air mixed with moisture, and the writer states that as no percentage of moisture, under 5 per cent. can restrain a coal-dust explosion, it is not surprising that in the disasters at Tylorstown, Universal and MacLaren collieries, the flame swept along the watered parts of the road as if they were charged with gas. Experiments made in Germany supported this view, as they proved that water had no restraining influence on an explosion of coal dust, unless the dust was so wet that water could be squeezed out of it by the hand. It was useless therefore to depend on watersprays for restraining the extension of an explosion after it is once initiated. The paper deals with the danger of extending ankylostomiasis by watering underground and, in summing up the contrary interests involved, asks: (1) shall we attempt the impossible task of limiting a possible explosion, or (2) shall we give attention to the comfort and health of underground labour and reduce spraying to a sanitary point."

In the discussion which followed, a suggestion was made that oil might be used with advantage in laying coal dust.

Mr. J. B. Atkinson, H.M. Inspector, said the addition of salt to the water would be more in the right direction, and it might be worth while to try and send air into the mine at considerably above the normal temperature with a view to its depositing moisture as it went round the workings. The chemical aspect of the question was also raised.

Mr. J. P. Kirkup said that watering deep mines would render them intolerably oppressive, and Mr. C. H. Merivale, in confirming this, mentioned some Belgian mines where watering was discontinued so that the workmen could be kept cool and in a fit state to work.

ELECTRICAL EQUIPMENT OF AUTOMOBILES.

A paper on the subject was read before the Manchester Section of the Institution of Electrical Engineers at the last meeting by Mr. H. V. Mahler. The following is an abstract.

The author's object is to explain the different methods of producing electric ignition. He deals first with the high tension system, and devotes particular attention to the contact breaker, which serves the purpose of starting and stopping the current in the primary coil at the right instant, so as to produce the spark. In many systems a separate coil is required for each cylinder, but a system has been introduced by Mr. S. F. Edge, whereby one coil will do the work for any number of cylinders. A similar system is employed on the new 15-h.p. four cylinder De Dion motor. In this case, the cam is made with four projections instead of one, and this causes the blade to make contact with the platinum-pointed screw four times in one revolution of the half-time shaft, and so operates the single trembler coil equally four times in the same period of time. The

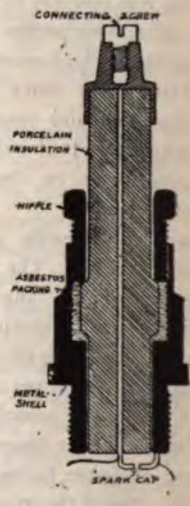


FIG. I.
SPARKING PLUG.

production of four-spark discharges at regular intervals of time from the coil are thus obtained, but of course these have to be distributed to the four cylinders of the engine in proper sequence.

It will be evident that the service of high-tension current to the cylinder is made with the utmost regularity, without any interference from the advance and retardation of the ignition, which is obtained in the usual simple way by partially rotating the primary current contact-breaker on its boss round the half-time shaft.

The author also refers to the Garrard-Maxfield contact breaker, which is an abnormally quick contact breaker, and which has only lately been put on the market. This contact breaker, fig. 2, has two plunger rods, both controlled by spiral springs. Where these meet in the centre of the socket they are tipped with platinum. The upper plunger is insulated from the lower plunger by means of a fibre bushing The electric wire is attached to the upper plunger. In action, when the cam piece comes round, it forces the contacts hard together in opposition to the spring tension, so that when the lower plunger is released, the springs cause the platinum to separate with an extremely sharp action, thus causing an intense spark at the plug even at the highest speeds.

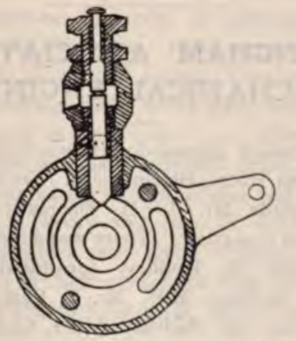


FIG. 2.—GARRARD-MAXFIELD CONTACT-BREAKER, WITH COVER REMOVED SHOWING SPRINGS AND PLUNGERS.

The author also deals with the subject of magnetic ignition. The advantages of the system are: The absence of accumulators and coil; there is no recharging required; freedom from breakdown through leakage or short circuit; and certainty of ignition at high speeds.

MAGNETIC IGNITION.

The most generally adopted and easiest system of magnetic ignition is the Eisemann system. In this system the armature rotates and gives a low-tension current. On this dynamo there is a make and break. The low tension current is taken into an induction coil and then transformed into a high tension current in the usual accumulator and coil system. The armature is generally driven from the engine shaft by a chain and the current is collected from two contact rings and brushes. From one of these brushes it passes into the primary winding of the coil, and returns back to the other brush from the coil, and through an interrupter on the armature shaft. On this system an ordinary sparking plug is used. It will, therefore, be readily seen that in the case of break down of the dynamo the accumulator and coil system can easily be adopted. The spark is advanced and retarded simply by altering the position of the make and break on the dynamo shaft. This system will spark at a very slow speed, and works well under all possible conditions met with. In fact, this is without doubt the leading and most commonly used system.

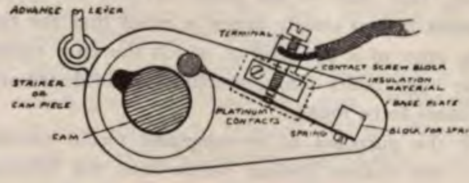


FIG. 3.—POSITIVE "MAKE" CONTACT-BREAKER.

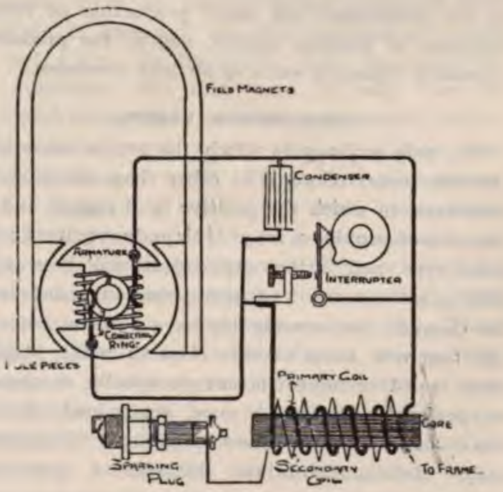


FIG. 4.—DIAGRAM OF EISEMANN HIGH-TENSION MAGNETO.

RECENT DEVELOPMENTS IN ELECTRIC LIGHTING.

A paper on this subject was read before the Junior Institution of Engineers on Friday last by Mr. H. T. Davidge, Professor of Engineering at the Ordnance College, Woolwich.

The following is an abstract of the paper :—

In considering a central electrical station designed for lighting purposes only, as many are, or in any station, that part of the plant devoted to lighting, it cannot be too clearly borne in mind that the lamp is the apex of a pyramid of which the base consists of the huge boiler plant, machinery and distributing gear there to be found.

For the purposes of investigating recent developments the author divides lamps into the following classes: A—Incandescent carbon lamps (1) arc lamps, (2) filament lamps of pure carbon, (3) filament lamps of compounds of carbon; B—Non-carbon lamps (1) arc lamps, (2) filament lamps, (3) electrotype lamps, (4) vapour lamps (5) cathodic bombardment lamps, (6) high frequency lamps without wires.

For many years the principal developments in arc lamps consisted in perfecting the mechanism to ensure regularity of feed, and the adaptation of the feeding mechanism to alternating current when this became necessary.

A typical continuous current arc lamp is shown by the Brockie-Pell. With regard to carbon filament lamps it may be said that the only advance made in connection with this class of lamp has been in the economical and rapid production of reliable filaments of uniform quality, and in the production of reliable filaments suitable for high pressures.

NON-CARBON LAMPS.

The only arc lamp in which the arc is maintained between pieces of material other than carbon is the Steinwetz, in which the positive is of copper and the negative of an oxide of iron. It is undoubtedly of a very novel type, and further experiments will be watched with great interest. Of non-carbon filament lamps the Osmium may conceivably have a future before it, but any new lamp of this class to make headway must be either more efficient electrically or cheaper, or, preferably, both. A most determined effort in this direction is to be found in the new "Tantalum" lamp. Metallic tantalum, hitherto a practically unknown element in the pure state, has been made to form filaments, and these are of a very tough and reliable nature. The resistance of tantalum, like most metals, increases with temperature, the opposite of carbon; hence variations of the pressure do not tend to have such harmful effects upon this lamp as upon the carbon lamp. The results of tests appear to indicate that a 25-candle-power 110 volt lamp will have an efficiency of about 1·5 watts per candle when new, falling to 2·1 watts per candle-power after 1,000 hours. Among electrolytic lamps the Nernst is now well known, and it seems probable that with still further improvement the lamp has a great future before it.

Mercury vapour lamps also promise well. The Cooper-Hewitt has been described in PAGE'S WEEKLY, and the Bastian lamp is said to have been brought to a stage of being made suitable for alternating currents. The colour difficulty is also being combated by the makers of mercury vapour lamps by the introduction of substances, the spectrum of which would contain the red rays.

In conclusion, the author says that the final solution of the lamp problem has still to be made. If the engineer could but discover the secret of the firefly which gives out luminous radiation without heat waves the light of the future might be found. In that case it might be chemical and not electrical illumination.

A hopeful outlook for electrical engineers is in the direction of high-frequency alternations.

BIRMINGHAM ASSOCIATION OF MECHANICAL ENGINEERS.

The fourteenth annual dinner was held on Saturday at the Grand Hotel, Birmingham. Sir William White presided, while Mr. T. H. Dacres (vice-president) occupied the vice-chair. There was a large attendance, including Mr. R. Holliday (president), the Right Hon. Jesse Collings, M.P., Mr. E. Parkes, M.P., Professors Turner and Redmayne, Dr. Sumpner, Colonel E. J. Hart, Colonel Kimberley, Alderman Johnson, Messrs. E. B. Edmonds, Hugo Gibson, C. Y. Hopkins, W. H. Thornbery, J. Bettany, R. B. Hodgson, H. J. Grant, W. Deakin, Louis O'Brien (secretary), W. Playdon (assistant secretary), A. Cooke (treasurer), E. A. Lees, H. Toy, H. Austin, J. Pugh, C. A. Smith, J. S. Morris (London), J. H. Whitehead (Leeds), D. Cookson (Newcastle), Smith (Middlesbrough), Finlay Ross (Glasgow), T. Taylor (Woolwich), Marshall Halstead (U.S.A. Consul), and J. Cox. Letters of apology for non-attendance were read from the Right Hon. Austen Chamberlain, M.P., the Right Hon. Joseph Chamberlain, M.P., Lord Morpeth, Sir Benjamin Stone, Sir Alfred Hickman, and Sir J. Kitson.

Mr. E. Parkes, M.P., in proposing the City of Birmingham, said he believed the new University was destined to exert a large influence as a scientific University not only in Birmingham, but also in the country at large. He believed it would be one of the most remarkable examples of what they might term a modern University. They seemed to be entering upon a new phase of commercial and industrial life. One of the best things that could happen to Birmingham, would be greatly improved and cheaper facilities by means of which they could get their goods to the coast.

THE IMPORTANCE OF THE MECHANICAL ENGINEER.

Sir William White proposed the toast of "The Association." Birmingham, he said, was the great centre of mechanical engineering. Birmingham had coal at her doors, iron not far away, and every facility for modern manufacture. Birmingham, too, was the birthplace of the Institution of Mechanical Engineers. Mechanical engineering lay at the root of all engineering, and it was essential that whatever branch they went in for, they should have a training in mechanical engineering. As an example of what Birmingham had achieved he might refer to the Welsh water scheme as a triumph of engineering skill. It was a great work, and Mr. Mansergh's boldness of design and courage in execution of works of immense expense should never be forgotten. Here again, one saw that without the mechanical engineer the other departments of engineering could never have accomplished the work involved in the Welsh water scheme.

He hoped the Association would draw nearer to the University, and help it with advice and assistance when required. Theory and practice must not be divorced. They must not teach without work, and he was glad that in their connection with the technical school there was this recognition of scientific training.

INSTITUTION OF CIVIL ENGINEERS.

A meeting of the Association of Yorkshire Students of the above Institution was held in the Law Institute, Leeds, on February 2nd, the President (Mr. Ewing Matheson, M.Inst.C.E.) in the chair, when a paper was read by Mr. K. Lightfoot, Stud.Inst.C.E., on "Modern Refrigerating Machinery."

Mr. Lightfoot explained the action of a refrigerating machine and worked out expressions for the efficiency and the co-efficient of performance. He then gave descriptions of the various systems now used commercially, namely, the absorption, dry air, and compression machines, and discussed the question of the employment of ammonia, carbonic acid, or sulphurous acid for the working substance in the latter type of machine, which is by far the most efficient. Various parts of a modern compressor were described in detail, and the application of the compression system to the production of ice and the cooling of stores was shown.

A discussion followed.

FUEL ECONOMY IN STEAM POWER PLANTS.

The discussion on Messrs. Booth and Kershaw's paper was concluded at the last meeting of the Institution of Electrical Engineers.

Mr. Halpin said that radiation in pipes was a thing over which great care must be taken. With regard to mechanical stoking, he believed that the chain grate left a good deal to be desired owing to the large quantity of air let in.

Mr. Rosenthal, speaking from experience, said that central station engineers were well acquainted with the subject dealt with. The question of thermal storage was not the mystery the authors of the paper seemed to suggest, and the results referred to as being achieved at the Kensington station were only what he should have expected thermal storage to achieve Then, again, it was suggested that to analyse coal, the flue gases, and feed water, some special training was necessary. That was not so, for they were, after all, very simple matters, and any central station engineer could easily acquaint himself with all that was necessary to know in that connection. He did not agree with the reference to barbarously designed boilers; the results given by modern boilers disproved such a charge. It was said, too, that mechanical stokers were not a cure for the smoke evil; he could say most positively, that they were the only cure for smoke with smoke fuels, and that no amount of furnace design would prevent smoke unless the boiler was practically doing no work. He made that statement on the strength of twenty-five years' experience. Excess of air was a trouble in furnace management always, but, perhaps the authors of the paper were not aware that there were devices which enabled boiler plant to be run with 10 to 12 per cent. of CO_2. With regard to superheating the gain was on the coal bill, and central station engineers, of whom there were many present, would bear him out that they were quite alive to the importance of that question. One of the latest installations was at Hampstead, where a separately-fixed superheater had been put in. The advantages in regard to fuel economy were not so great as with a superheater which was an integra part of the boiler, but even under these conditions the saving of fuel per unit generated was 10 per cent. Mr. Molesworth said that the authors made no reference to pulverized coal, but it was possible to effect a great saving in fuel consumption by its use. A comparison he had instituted between two Babcock and Wilcox boilers was that the saving with pulverised coal was 29 per cent. That was the figure with equal evaporation, but with an equal amount of coal the increased evaporation was 48 per cent in favour of pulverised coal.

Other speakers referred to the difficulty of burning bituminous fuel without smoke in a large station at times of sudden demand, to the advantages of the use of glazed bricks in boilers (which had the secondary purpose of minimising air leakage); to the bad fixing of ironwork, and to the disadvantages arising from expansion in boilers.

Mr. Booth, in his reply, denied that he was opposed to water-tube boilers.

The discussion was, however, curtailed by the time limit, and some notable contributions handed in will only be available in the official report.

MR. MARCONI'S FORTHCOMING MARRIAGE.

More than one story has been current recently as to the forthcoming marriage of Mr. Marconi. The industrious paragraphists have pledged the affections of Mr. Marconi in a wholesale kind of way, and have not hesitated to give their stories a touch of veracity by the addition of names and details. It is well therefore to state that an engagement has been authoritatively announced between Mr. Marconi and the Hon. Beatrice O'Brien, sister to Lord Inchiquin, and one of the pretty daughters of Ellen Lady Inchiquin. Mr. Marconi is Irish by right of his mother, and his future wife is a young and charming Irishwoman. The O'Briens are one of the most ancient families in Ireland. They claim descent from the great warrior who fell at the battle of Clontarf in 1014; and also from a Murrough O'Brien, brother of a king of Thomond. The barony dates from 1543.

Guglielmo Marconi was born in Bologna, April 25th, 1875. He was educated in Leghorn, under Professor Rosa, and, subsequently, at the University of Bologna, in which city were carried out the first experiments in connection with his system of wireless telegraphy. Marconi's invention was successfully tested in England between Penarth and Weston, and later by the Italian Ministry of Marine at Spezia. Wireless telegraphic communications were established between France and England in 1899; two years later he was enabled to transmit signals across the Atlantic Ocean from Poldhu, Cornwall, to St. John's, Newfoundland. In 1902, Mr. Marconi's system was installed on board the Italian cruiser *Carlo Alberto*, and during her voyage from England to Russia, he received messages from Cornwall and transmitted them to the Tsar and the King of Italy at Kronstadt. Later on, in December of the same year, he was able to announce the establishment of his system of wireless telegraphy between Canada and England. This was followed, a few weeks later, by the transmission of a message from the President of the United States to the King of England, inaugurating wireless connection between Cape Cod (Mass.) and Cornwall.

EAST BOSTON TUNNEL.

The East Boston tunnel, completed by the Boston Transit Commission, runs beneath a wide arm of Boston Harbour and is about 7,480 ft. in length. It is the only double track tunnel thus far built in America. The engineer taking advantage of the firm nature of the boulder clay, built the tunnel with a semi-circular roof, perpendicular side walls, and a flat invert. The irregular section that this method necessitated made it impossible to use a shield in the ordinary way. Consequently a semi-circular half shield was used for the construction of the upper half of the tunnel, and the lower half was built by means of drifting.

Two bulkheads were constructed, one at each end of the central portion of the tunnel extending below the river, and these were provided with the usual air locks. The next step was to drift out two small tunnels, one in the line of each side wall, and large enough to permit these walls to be built therein. The walls were built of concrete, and carried up to the springing of the semi-circular arch. On the top of the walls was laid a heavy trackway, upon which rested the ends of the semi-circular shield. The shield was then advanced by hydraulic pressure in the customary way, the clay being dug out, passed back through the central openings, and removed through the air locks. The concrete roof, 3 ft. in thickness, was then rammed into place, being temporarily supported on falsework, in the customary manner. The material lying between the side walls was then excavated down to grade and the concrete invert was built in place. Except for a blowout and one or two minor accidents, this very bold and original method of excavation was carried through successfully. For the above details as well as for the illustration on p

the Scientific American.

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts.

CONTRACTS OPEN.

Last Day.

East Ham.—Supply and delivery of five double-deck roof-covered tramcars complete with electrical equipment for the Borough Council. Mr. W. C. Ullmann, Nelson Street, East Ham ... ... Feb. 21

Newcastle-under-Lyme—Manufacture delivery and erection of three sets of gas engines and centrifugal pumps for sewage disposal works. Messrs. Wilcox and Raikes, 63, Temple Street, Birmingham... Feb. 22

Fulham. — Supply of condensing plant, boilers, economisers and stokers. Mr. Arthur J. Fuller, Borough Electrical and Consulting Engineer, Town Hall, Fulham Feb. 22

Uganda.—The Crown Agents for the Colonies invite tenders from manufacturers for the supply of galvanised wrought-iron piping and fittings to the Uganda Railway. Specification and form of tender for which can be obtained on application to the Crown Agents... ... Feb. 22

Islington. — Supply of electrical and engineer's stores for one year from April 1 next. Mr. W. F. Dewey, Town Clerk ... Feb. 23

Chelmsford.—Pumping machinery including horizontal gas-engine and a vertical treble ram-pump to raise 10,000 gallons of water per hour. Mr. Jos. Dewhurst, Engineer, Avenue Chambers, Chelmsford. Feb. 24

Sunderland.—Supply of four 250-kw. synchronous three-phase motor-generators, for the Corporation. Mr. J. F. C. Snell, Town Hall, Sunderland ... ... Feb. 24

Copenhagen.—Supply and erection of a gasometer of a capacity of 200,000 cubic feet per hour for the Lighting Department of the Corporation. Valby Gasworks, Valby, Copenhagen ... ... Feb. 27

Barcelona.—The "Gaceta de Madrid" of January 18th contains a notice calling for tenders for the supply and installation in the sheds of the Barceloneta wharf of two transhipment cars for platform cranes. Conditions of contract and plans may be inspected at the offices of the Secretary of the Port Administration, Casa Lonja, Barcelona ... ... March 1

Wimbledon.—Supply of stores to the Electricity Department for one year from April 1. Electrical Engineer, Durnsford Road, Wimbledon ... ... March 4

Johannesburg.—Supply of 100 electric cars, two electric water-cars, five-ton crane, car traverser, and workshop tools for Municipal Council ... . March 6

Stoke Newington.—Supply, délivery and erection of sub-station plant and mains. Four-section contract. Mr. W. F. Loveday, Borough Surveyor, Town Hall, Milton Road, Stoke Newington, S.E. ... ... March 8

Last Day.

Newport (Mon.).—Construction of main outfall and branch sewers for the Western Valleys Sewerage Board. Particulars at offices of Mr. Baldwin-Latham, Parliament Mansions, Victoria Street, S.W.; Mr. Geo. Chatterton, 6, The Sanctuary, Westminster, S.W.; or Mr. T. S. Edwards, Clerk to the Board, Newport (Mon.) ... April 8

Park Royal.—Supply, delivery, and erection of plant in connection with the electricity generating station at Park Royal and proposed sub-stations and distributing centres at various places, for the Great Western Railway Company. Messrs Kennedy and Jenkin, 17, Victoria Street, S.W. ... ... March 13

Belgium.—The "Bulletin Commercial" announces that the Belgian State Railways invite tenders for the installation of two sets of ventilating and heating apparatus in the central workshops at Mechlin. Particulars of M. Slaghmuylder, Engineer-in-chief, Station du Nord, Brussels ... March 6 March 13

South Shields.—Supply, delivery and erection of the following plant in connection with the electricity supply department:—One multitubular marine type boiler, two medium-speed open-type vertical engines for two 550 k w. direct current traction generators, two 500 k.w. direct current generators and traction switchboard. Mr. J. H. Cawthra, Borough Electrical Engineer March 13

Shanghai.—The Shanghai Municipal Council invite tenders for the construction and operation of about 24 miles of electric tramways on the trolley system in the streets of the Settlement of Shanghai; alternative proposals are desired for the single-trolley and double-trolley lines. Council's agents, Messrs. John Pook and Co., 63, Leadenhall Street, London, E.C., and Messrs. Fearon Daniel and Co., 90, Wall Street, New York. ... ... March 31

COMING CONTRACTS.

Mexico.—The "Diario Oficial" of Mexico, of January 12th, publishes the text of a Decree, authorising the Intercontinental Railway Syndicate to establish a smelting works either in the town of Guanajuato or on a site in the State of Jalisco, between the Pacific coast and the towns of Dolores Hidalgo, Guanajuato and Leon. All the machinery may be imported free of duty.

Austria-Hungary.—The "Moniteur des Intérêts Materiels" (Brussels) states that the Austrian Lloyd Company will shortly invite tenders for the construction of two steamers for use on an express service.

Maidstone.—An inquiry has been held into the application of the Town Council for sanction to borrow £60,000 for extending the light railway service.

Uxbridge.—Tenders are to be advertised for in connection with waterworks improvements.

Brazil.—The Budget expenditure of Brazil for 1905 makes provision, *inter alia*, for the disbursement of certain sums on submarine construction; plants and seeds for agriculturists; cattle for stock-breeding; railway construction; dredging works, waterworks and river improvement works.

Indo-China.—The French "Journal Officiel" of January 31st publishes a Decree authorising the construction of the following railways in Indo-China: (1) An extension of the Saigon railway to Khan-Hoa to cost 29,200,000 fr. (2) A line from Phan-rang to Danhim, being the first section of the Lang-Bian branch line to cost 11,500,000 fr. (3) A line from Hué to Kwangtri to cost 7,300,000 fr.

Stockton.—The existing destructor is to be extended at a cost of about £2,500.

Dumfries.—It is estimated that the total cost of the sewage purification works will amount to £39,000, and a further sum of £9,000 is to be borrowed.

Italy.—The Italian Government will on May 3rd offer a concession for the building of the Apulian aqueduct, the cost of which is estimated at £5,400,000. A deposit of £24,000 is required.

Sydney.—The Government has decided to advertise for tenders for the manufacture of iron from local ores to supply railway and other works.

CONTRACTS CLOSED.

Japan.—The Japanese Government has placed a contract with the North British Locomotive Combine, Glasgow, for 50 powerful locomotives. These are in addition to an order for a score of engines at present building for Japan. The contract is for prompt delivery. The Glasgow firm will ship the first order next month.

East Ham.—The tender of Meldrum Bros., Ltd. of Timperley, has been accepted for the erection of 6 of their Patent "Simplex" Regenerator Cells at East Ham Sewage Works.

Transvaal.—Ernest Newell and Co., Ltd., have secured a large order for tube mills for a gold-mining company in the Transvaal.

Consett.—The Consett Iron Company, Ltd., have placed orders for the construction, at Templetown, Consett, of fifty patent Otto-Hilgenstock coke ovens.

Mold.—The North Hendre Lead Mining Company, Ltd., Mold, have given a contract for a cross compound condensing horizontal-geared pumping engine to Andrew Barclay, Sons and Co., of Kilmarnock. The cylinders are to be 20 and 36-in. diameter by 34-in. stroke, and the steam pressure 70-lb. per square inch.

Middleton.—The Corporation have accepted the tender of Meldrum Bros., Temperley, Manchester, for a dust destructor; the tender of W. B. Haigh and Co., Ltd., Oldham, for the superheater; and that of Tetlow Bros., Hollinwood, Oldham, for boiler at the electricity station.

Battersea.—The Council have accepted the tender of C. A. Parsons and Co., at £4,680, to supply and fix one 750 k.w. turbo-generator set at the central electric generating station; the offer of Green and Sons, at £494 17s., to supply and erect at the central electric generating station a special fuel economiser, consisting of 236 tubes.

Sydney.—The City Council have accepted the tender of Henley's Telegraph Works Company for the making of house connections and the laying of electric light cables.

APPOINTMENTS VACANT.

Last Day.

Leeds.—The City Council have decided on the appointment of a waterworks engineer, at a salary of £1,000: Mr. Robert Fox, Town Clerk ... ... Feb. 28

Ayr.—Tramways Manager under the Corporation. Salary £200 per annum. Mr. David Stewart, Council Chambers, Ayr ... ... Feb. 18

Croydon.—Electrical Superintendent of Works. Salary £150 per annum. Mr. Alex. C. Cramb, Electricity Works, Factory Lane, Croydon ... ... Feb. 17

Birmingham.—Chemist to take charge of a new 20-ton per diem coal-testing plant, fitted with regenerative retort settings. Chairman of Works, Sub-Committee of Gas Department, Council House, Birmingham ... ... Feb. 20

City Corporation.—Mr. D. J. Ross, engineer and surveyor to the City Corporation, is retiring on account of ill-health. It has been decided to advertise for a successor. The salary is fixed at £1,500, rising to £2,000. Candidates must not be over fifty years of age ... . —

London County Council.—Engineering assistant, at a salary of £500 per annum. Must be a member or associate member of the Institution of Civil Engineers, and have had experience. Particulars of Clerk to the Council, Spring Gardens, S.W. ... ... Feb. 20

Newcastle.—Electrical Engineers to take charge of shift at Carville Power Station. Mr. J. S. Watson, Newcastle-upon-Tyne Electric Supply Company ... ... —

London.—Assistant at the City and Guilds Central Technical College, to teach mechanical drawing and mechanism. Salary £150 per annum. Prof. Dalby, at College, Exhibition Road, S.W. ... ... —

APPOINTMENTS FILLED.

Paisley.—Mr. Frederick Coutts, general manager of the Ayr Corporation tramways, has been appointed manager of the Paisley tramways at a commencing salary of £400 per annum.

Johannesburg.—Mr. G. H. Stanley, A.R.S.M., the Demonstrator in Metallurgy and Surveying in the Armstrong College, Newcastle, has recently received a very important appointment in South Africa, having been elected to the Professorship of Metallurgy in the Technical Institute, Johannesburg.

South Kensington.—The President of the Board of Education has appointed Prof. Henry Adams, M.I.C.E., late of the City of London College, to be a member of the Board of Examiners at South Kensington in the engineering section.

Bradford.—The Bradford Electricity Committee have appointed as assistant electrical engineer Mr. Charles William Salt, of Croydon, at a salary of £250 a year.

Dover.—The Dover Town Council have accepted the resignation of the station superintendent, T. McGill, and have appointed C. H. Lydall at £150 per annum.

Wakefield.—Mr. Harry A. Nevill, first assistant electrical engineer, has been appointed city electrical engineer of Wakefield, at a salary of £300 a year.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares business is rrently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our ist will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from inaccuracies.

STOCK EXCHANGE SETTLING DAYS.—Settling days on the Stock Exchange are as follows :—
ls: March 1st. General Settlements: February 24th, March 15th, 30th. Bank Rate, April 21st, 1904, 3 per cent.

-ENGINEERING, IRON, AND STEEL COMPANIES.

Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
5	5%	Alldays & Onions Pneumatic Engineering, Ltd.	3	2½—3
5	3/-	Do. Cum. Pref. 6 per cent. ..	5	4½—5
1	2/6	Armstrong (Sir W. G.), Whitworth and Co., Ltd.	1	3 5/16—3 7/16
5	2/-	Do. 4% Cum. Pref.. ..	5	5⅜—5⅝
100	4%	Do. 4% 1st Mort. Dbs. Rd.	100	103—105
100	4½%	Aveling and Porter, Ltd., 4½% Reg. Mt. Debs. Red.	100	96—99
1	1/7½	Babcock and Wilcox, Ltd., Ord. ..	1	4—4¼
1	7⅕d.	Do. ,, 6% Cum. Pref.	1	1½—1⅝
5	3/-	Baker (Joseph) and Sons, Ltd., 6% Cum. Pref.	5	5—5½
1	6⅗d.	Baldwins, Ltd., 5½% Cum. Pref. ..	1	1—1⅛
Stk	4½%	Do. 1st Mt. 4½% Deb. Stk. Red.	100	101—103
4½	2/8⅗	Barrow Hæmatite Steel Co., Ld., O.	4½	1 9/16—1 11/16
4½	6/-	Do. do. Cum 2nd. Pref.	4½	4½—4¾
5	2/6	Bayliss, Jones and Bayliss, Ltd., 5% Cum. Pref. Shares	5	4¾—5¼
100	—	Beardmore (Wm.) & Co., Ltd., 4½% 1st Mt. Debs., Red., Scrip 50% pd	—	101—103
10	6/-	Bell Brothers, Ltd., 6% Cum. Pref.	10	11¾—12¼
Stk	4%	Do 4% Deb. Stock, Red.	100	99—101
1	1/-	Beyer, Peacock and Co., Ltd., Ord.	1	⅝—11/16
1	6⅗d.	Do. 5½% Cum Pref.	1	25/32—27/32
Stk	4¼%	Do. 4¼% Red. Deb. Stock	100	94—97
1	6d.	Bolckow, Vaughan and Co., Ltd., O. Nos. 1-1,629,760	1	1—1 1/16
1	3⅗d.	Do. Nos. 1,639,101-3,500,000	12/-	17/32—19/32
1	4⅙d.	Brown (John) and Co., Lim., Ord., Nos. 1-1,160,000	15/-	1¼—1⅜
1	6d.	Do. Ord., Nos. 1,160,001-1,750,000	1	1 25/32—1 27/32
10	5/-	Do. 5 % Cum. Pref.	10	11¼—11¾
5	2/6	Cammell, Laird & Co., Ltd., Ord. ..	5	8¼—8¾
5	2/6	Do. 5% Cum. Pref. ..	5	5¼—5½
1	1/6	Clayton & Shuttleworth, Ltd., Ord.	1	31/32—1 1/32
5	2/6	Do. 5% Cum. Pref.	5	5⅜—5⅝
Stk	4%	Do 4% 1st Mort. Db. Stk. Red	100	100—102
10	7/6	Consett Iron Co., Ltd., Ord.. ..	7½	31½—32½*
10	10/-	Crossley, Bros., Ld., Ord. 40340/97370	10	16¼—16¾
10	5%	Do. 5% Cum. Pref.	10	11¼—11¾
1	2/6	Delta Metal, Ltd. Shares	1	2⅛—2¼
1	3⅗d.	Dorman, Long & Co., Ltd.	1	19/32—21/32
Stk	4%	Do. 4% 1st Mort. Perp. Deb. Stk.	100	91—94
5	3/-	Dunderland Iron Ore Co., Ltd., 6% Cum. Pref. and Participating..	5	3½—3⅝
1	9⅗d.	Dunlop (James) & Co., Ltd., Ord...	1	⅝—¾
1	7⅕d	Do. 6% Cum. Pref. ..	1	15/16—1 1/16
13	12/-	Ebbw Vale Steel, Iron & Coal Co., Ltd.	13	9—10
13	12/-	Do. do. do.	10	7¾—8
10	8/-	Elliott's Metal, Ltd.	8	5—5½
10	5%	Do. Cum. Pref. 5%	10	8¾—9¼
Stk	4%	Do. Deb. 4%	100	94½—96½
10	6/-	Fairfield Shipbuilding & Engng. Co., Ltd., 6% Cum. Pref. ..	10	10½—11
Stk	4½%	Do. 4½% Mort. Deb. Stk. Red.	100	97—100
10	10%	Fleming & Ferguson, Ltd. Ord. Nos. 1/9000..	10	12¾—13¼
10	5%	Do. 5% Cum. Pref. Nos. 9001/15000	10	9½—10
3	3/-	Fraser & Chalmers, Ltd., Ord. ..	3	4⅝—4⅞
3	1/6	Do. 7½% Cum. Pref.	3	5¾—6¼
10	5%	Galloways, Ltd., 5% Cum. Pref. 18001/28000	10	6—7
Stk	4%	Do 4% 1st Mort. Deb Red..	100	90½—91½
10	—	Greenwood & Batley, Ltd., Ord. ..	10	4—4½
10	7%	Do. 7% Cum. Pref	10	10¼—10¾
1	10%	Guest, Keen & Nettlefolds, Ltd. Ord.	1	2¼—2⅜
5	2/6	Do. 5% Cum. Pref.	5	5⅞—6⅛
Stk	4%	Do. 4% Irred. Mort. Deb. Stk	100	105—107
5	2/6	Gwynnes, Ltd., 5% Cum. Pref. ..	5	2—3
1	1/-	Hadfield's Steel F'dry Co., Ld., Ord.	1	3 5/16—3 7/16
10	4/6	Do. 4½% Cum. Pref... ..	10	10¾—11¼
5	3/-	Hall (J. & E.), Ltd. 6% Cum. Pref...	5	5—5½
1	1/6	Harvey United Steel Co., Ltd. ..	1	1 5/16—1 7/16
10	7½%	Hawthorn, Leslie & Co., Ltd. Ord.	10	11—11½
5	7/-	Head, Wrightson & Co., Ltd. ..	5	4¾—5¼
1	7⅕d.	Hill (Richard) & Co. (1899) Ld., Ord.	1	⅝—¾
5	3/-	Do. 6% Cum. Pref.	5	4⅝—4⅞*
10	6/-	Hornsby (Richard) & Sons, Ld., Ord.	8	5½—6

ENGINEERING, IRON, AND STEEL COMPANIES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
750,000	1	6d.	Howard & Bullough, Ltd., Ord. ..	1	1 11/16—1 13/16
25,000	10	6/-	Do. 6% Pref. (Non-Cum.) ..	10	12¼—12¾
£250,000	Stk	4%	Do. 4% Deb. Stk., Red. after 1905	100	98—101
37,500	10	20	Kynoch, Ltd.	10	19—20
49,587	10	5%	Do. Cum. Pref. 5%	10	10¾—11
300,000	1	4⅘d.	Lambert Bros., Ltd., Ord.	1	⅝—⅞
50,000	5	2/9	Do. 5½% Cum. Pref.	5	4—4½
40,000	8	2/1⅗	Leeds Forge Co., 7% Cum. Pref. ..	8	3¾—4¼
200,000	1	7⅕d.	Lysaght (John), Ltd., 6% Cum. Pf.	1	1 5/16—1 7/16
£300,000	Stk	4½%	Do 4½% 1st Mt. Deb. Stk., Red.	100	108—110
40,000	10	5/-	Mather & Platt, Ld., 5% Cum. Pref	10	11—11½
210,000	1	6d.	Measures Bros., Ltd., Ord.	1	11/16—13/16
75,000	1	6⅗d.	Do. 5½% Cum. Pref.	1	13/16—15/16
£75,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	94—97
21,943	5	2/6	Muntz Metal, Ltd.	5	5⅜—5⅝
14,248	5	5%	Do. Pref. 5%	5	5⅛—5⅜
5,000	62½	47/6	Nantyglo and Blaina Iron Works, Ltd., 8% Cum. Pref.	62½	74—76
73,000	10	5/-	N. Brit. Loco. Co., Ltd., 5% Cm. Pf.	10	11⅞—12⅛
80,000	5	—	North-Eastern Steel Co., Ltd., Ord.	5	—
£250,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	90—93
122,000	5	2/-	Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B"	5	3¾—4
50,000	5	3/-	Do. 6% Cum. Pref. "A" ..	5	5¾—6¼
70,000	10	6/-	Pease & Partners, Ltd., Ord. ..	10	9¼—9¾
£400,000	Stk	4%	Do. 4% Perp. Deb. Stock ..	100	97—100
20,000	5	3/-	Peebles (Bruce) & Co., Ld., 6% Cm. P.	5	4¾—5
65,000	1	—	Pooley (Henry) & Son., Ltd., Ord ..	1	3/6—4/-
13,000	5	—	Do. 5½% Cum. Pref.	5	2⅞—3⅛
230,000	1	—	Projectile Co. (1902), Ltd., Ord. ..	1	½—⅝
126,938	5	2/-	Rhymney Iron Co., Ltd.	5	1¾—2
73,062	5	2/-	Do. New	5	1½—1¾
£330,000	—	5%	Do. 5% Mort. Deb., Red. ..	100	99—102
350,000	1	7⅕d.	Richardsons, Westgarth & Co., Ltd., 6% Cum. Pf. ..	1	⅞—15/16
£350,000	Stk	4½%	Do. 4½% Perp. Deb. Stock ..	100	94—96
35,000	10	12/-	Ruston, Proctor & Co., Ltd... ..	10	9¼—9¾
275.000	1	6d.	Scott (Walter), Ltd., Ord.	1	⅞—1
300,000	1	7⅕d.	Do. 6% Cum. Pref. ..	1	1—1⅛
£300,000	Stk	4%	Do. 4% Perp. Deb. Stk.	100	94—96
£115,300	100	5%	Shelton Iron, Steel and Coal Co., Ld. 1st Charge 5% Debs.. Red ..	100	91—94
£97,900	100	6%	Do. 6% 2nd Mort. Debs., Red.	100	91—95
250,000	1	1/-	South Durham Steel & Iron, Ltd. Or.	1	⅝—11/16
300,000	1	7⅕d.	Do. 6% Cum. Pref...	1	13/16—⅞
£300,000	Stk	4½%	Do. 4½% Per. Deb. Stock	100	89—92
49,560	10	2½%	Steel Co. of Scotland Ord. 1/49560. .	9	5½—5⅝
£125,240	Stk.	5%	Do. 5% Trust Mort. Deb. ..	100	106½—107½
25,000	10	—	Stephenson (Robert) & Co., Ltd., Or.	10	2⅛—2⅜
25,000	10	5/6	Do. 5½% Cum. Pref. ..	10	5—5½
£250,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	79—82
85,000	10	9/-	Stewarts & Lloyds, Ltd., Ord. ..	10	16¾—17¼
55,000	10	6/-	Do. 6% Cum. Pref.	10	14¼—14¾
634,732	1	4.69d.	Swan, Hunter & Wigham-Richardson, Lim. Ord.	1	⅞—1
538,845	1	6d.	Do. 5% Cum. Pref.	1	15/16—1 1/16
£240,000	Stk	4¼%	Do. 4¼% 1st Mort. Deb. Stk. Red	100	98—101
300,000	1	6d.	Thames Iron Works, Shipbuilding & Engineering Co., Ltd., 5% Cum. Pf.	1	½—9/16
£200,000	100	4%	Do. 4% Irredeem. 1st Mort. Deb.	100	67—71
£160,000	1	7⅕d.	Thornycroft (John I.) & Co., Ltd. 6% Cum. Pref.	1	15/16—1 1/16
10,000	10	5/-	Tylor (J.) & Sons, Ltd. 5% Cum. Pf.	10	9½—10
$508495200	$100	$½	United States Steel Corp. Com. Stk.	$100	32½—32¾
$360314100	$100	$1¾	Do. 7% Cum. Pref. Stock	$100	97⅛—97⅜*
$162268000	$1000	5%	Do. 10-60yr. 5% Skg. Fd. G. Bds.	$1000	96—98
3,350,000	1	1/-	Vickers, Sons & Maxim, Ltd. Ord..	1	2 7/16—2 9/16
750,000	1	6d.	Do. 5% Non-Cum. Pref. ..	1	1⅛—1¼
£750,000	Stk	5%	Do. 5% Non-Cum. Pref. Stock.	100	114—117
£1,250,000	Stk	4%	Do. 4% 1st. Mort. Deb. Stk. Red.	100	105—107
£1,000,000	100	4½%	Do. 4½% 2nd Mort. Debs., Red.	100	105—107
225,000	1	1/2⅖	Weardale Steel, Coal & Coke, Ltd., Def. Ord.	1	13/16—15/16
500,000	1	7⅕d.	Do. 6% Cum. Pref. Ord. ..	1	⅞—1
£300,000	Stk	4%	Do. 4% Perpetual Deb. Stock	100	85—89
7,637	5	2/9	Weldless Steel Tube, Ltd., Cum. Pref. 5½	5	4¾—4⅞
300	Stk	4½%	Do. Mort. Deb. 4½%	100	91—97
66,666	5	3/.	Willans & Robinson, Ord.	5	1½—2½
66,666	5	3/-	Do. 6% Cum. Pref.	5	3—4
£246,641	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red	100	77—82
£150,000	Stk	4½%	Yorkshire Iron & Coal Co., Ltd., 4½% 1st Mort. Deb. Stk. Red.	100	81—86

Stocks and Shares marked * are quoted ex-dividend.

II.—ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
70,000	1	6d.	Alliance Elec. Co., Ltd. 5% Cum. Pf.	1	⅝— ⅞
125,000	1	7½d.	Aron Elec. Meter Ltd., 6% Cum. Pf.	1	7/16— 9/16
120,000	1	9½d.	Bell's Asbestos Co., Ltd.	1	11/16— 13/16
100,000	5	4/-	British Insulated & Helsby Cables Ltd., Ord. ..	5	5¾— 6¼
100,000	5	3/-	Do. 6% Cum. Pref.	5	5½—5¾
£500,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Rd.	100	101 —104
£200,000	Stk	4½%	British Thomson-Houston Co., Ltd., 4½% 1st Mort. Deb. Stk. Red. ..	100	101 —103
400,000	5	3/-	British Westinghouse Electric and Manufac. Co., Ltd., 6% Pref. ..	5	2½— 2¾
£616,353	Stk	4%	Do. 4% Mort. Deb. Stk. Red...	100	87 — 89
105,731	2	2/-	Brush Elec. Enging. Co., Ltd., Ord. .	2	½— ¾
150,000	2	2/4⅘	Do. 6% Pref.	2	1⅜— 1⅝
£125,000	Stk	4½%	Do. 4½% Perp. 1st Deb. Stk...	100	93 — 96
£125,000	Stk	4½%	Do. 4½% Perp. 2nd Deb. Stk.	100	76 — 79
35,000	5	5/-	Callender's Cable & Constn. Ltd. Ord.	5	9½ - 10
40,000	5	2/6	Do. 5 % Cum. Pref.	5	5¼ - 5½
£200,000	Stk	4½%	Do. 4½% 1st Mort. Deb Stk. Red.	100	105 —107
85,000	3	1/6	Crompton & Co., Ltd...	3	2¼ — 2½
£100,000	—	5%	Do. 5% 1st Mort. Reg. Debs.	100	93— 98
52,000	5	10/-	Dick, Kerr & Co., Ltd., Ord. ..	5	7¾— 8¼
61,000	5	3/-	Do. 6% Cum. Pref.	5	5⅞— 6⅛
£300 000	Stk	4½%	Do. 4½% Deb. Stock, Red. ..	100	105 —107
233,334	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	1⅛— 1⅜
£233,334	Stk	4%	Do. 1st Mort. 4% free. Deb. Stk.	100	105 —108
99,261	5	1/6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	3	⅝— ⅞
17,139	5	2/6	Do. "A" Shares Nos. 01-017,139	5	1 — 1½
£344,023	Stk	4%	Do. 4% Deb. Stock Red. ..	100	77 — 82
£100,000	Stk	5%	Do. 5% Second Deb. Stk. Red.	100	79 — 84
112,100	2	1/7½	Electric Construction Co., Ltd. ..	2	1⅛— 1¼
31,390	2	2/9⅗	Do. 7% Cumulative Pref. ..	2	2¼— 2½
£200,000	Stk	4%	Do. 4% Perp. 1st Mt. Deb. Stk.	100	97 — 99
10,248	10	7/6	Evered and Co., Ltd...	10	13 — 15
£100,000	Stk	5%	Ferranti, Ltd., 5% 1st Mort. Deb. Stock, Red...	100	90 — 95
£25,000	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9½— 10
£200,000	Stk	4%	Do. 4% 1st. Mt. Deb. Stk., Red.	100	91 — 96
35,000	5	5/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	11 — 11½
35,000	5	2/3	Do. 4½% Cum. Pref... ..	5	5¼— 5½
£250 000	Stk	4½%	Do. 4½% Mt. Deb. Stk. Red.	100	111 —113
50,000	10	5/-	India Rubber, Gutta Percha & Telegraph Works Co., Ltd.,	10	15 — 16
£300,000	100	4%	Do. 1st Mort. Deb. Red. ..	100	99 —102
7,500	10	—	Parker, Thos., Ltd.	10	6½— 7
100,000	1	3%	Scott (Ernest) & Mountain, Ld., Ord.	1	16/-—16/6
37,350	12	12/-	Telegraph Construction and Maintenance Co., Ltd.	12	34 — 36
£150,000	100	4%	Do. 4% Deb. Bonds	100	101½-103½

III.—ELECTRIC TRACTION.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
120,000	5	3/-	Anglo-Argentine Trams Co., Ld., Or.	5	8⅜— 8⅝
260,007	5	2/6	Do. 5% Cum Pf.	5	5⅝— 5⅞
£230,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888 ..	100	140 —143
20,000	10	6/-	Barcelona Trams Co., Ltd., Ord. ..	10	11¾— 12¼
10,000	10	5/-	Do. 5% Cum Pf. Shares	10	9 — 10
£46,800	100	5%	Do. 5% Debs., Red. ..	100	99 —102
£191,846	Stk	4½%	Do. 4½% Red. Deb. Stk.	100	96 —100
75,606	1	—	Bath Elec. Trams. Ld., Pf. Or. ..	1	11/16— 13/16
59,394	1	11·49d	Do. 5% Cum. Pf. ..	1	15/16— 1 1/16
75,000	5	—	Brisbane Electric Tram Investment Co., Ltd., Ord... ..	5	1¼— 1¾
75,000	5	2/6	Do. 5% Cum. Pf. ..	5	3¾— 4¼
£425,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	94 — 98
£200,000	Stk	6%	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	102 —105
		%	Pref. Ord. Stock	100	100 —103
183,301	10	6/-	Brit. Electric Traction, Ltd., Ord.	10	9¼— 9¾
156,437	10	6/-	Do. 6% Cum. Pref.	10	11 —11¼*
£1,000,000	Stk	5%	Do. 5% Perp. Deb. Stk. ..	100	120 —122
£250,000	Stk	4½%	Do. 4% 2nd Deb. Stk. Red ..	100	97 — 99
100,000	5	1/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	3¾— 4
40,500	5	3/-	Do. "A" 6% Cum Pref. ..	5	5⅝— 5⅞
27,000	5	3/-	Do. "B" do.	5	5¼— 5½

Stocks and Shares marked * are quoted ex-dividend

ELECTRIC TRACTION.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£200,000	Stk	5%	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	94 —
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	99 —
102,268	5	3/-	Calcutta Tramways Co., Ltd. ..	5	8½—
£350,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	106 —
480,000	1	6d.	Cape Electric Tramways, Ltd. ..	1	1½—
40,000	5	2/6	City of Birmingham Trams Co., Ltd. 5 % Cum. Pref.	5	4¾—
£300,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	101 —
£120,000	Stk	5%	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	101 —
60,000	10	6/-	Dublin United Trams. Co. (1896), Ltd., Ord. ..	10	13 —
59,987	10	6/-	Do. 6% Pref...	10	15½—
30,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	3¼—
£150,000	Stk	4%	Do. 4% Deb. Stock.. ..	100	90 —
125,000	10	5/-	London United Trams. (1901), Ltd., 5% Cum. Pref.	10	10½—
£1,031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	101 —
£50,000	Stk	5%	Madras Electric Trams (1904), Ltd., 5% Deb Stock, Red.	100	101 —
314,016	1	—	Metropolitan Elec. Trams, Ltd., Def.	1	[illegible]
500,000	1	6d.	Do. 5% Cum. Pref... ..	1	[illegible]
£350,000	Stk	4½%	Do. 4½% Deb. Stock, Red.	100	104 —
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	½—
110,923	8	2/9⅗	North Metropolitan Tramways Co..	8	4½—
£150,000	100	3½%	Do. 3½% Mort. Debs.	100	99 —
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red..	100	102 —
24,500	10	10/-	Potteries Elec. Traction Co., Ld., Or.	10	8 —
24,500	10	5/-	Do. 5% Cum. Pref. ..	10	8½—
£220,000	Stk	4½%	Do. 4½% Deb. Stk., Red.	100	99 —

IV.—ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
7,500	10	16/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. ..	10	12½—
7,500	10	4/6	Do. 4½% Cum. Pref. ..	10	9½—
7,500	10	6/-	Do. 6% Cum. Second Pf. ..	10	11 —
£70,000	Stk	4½%	Do. 4½% Deb. Stock Red ..	100	104 —
14,000	5	2/-	Bromley (Kent) Elec. Lt. & Pr. Co. Ld	5	¾—
£50,000	Stk	4½%	Do. do. 4½% 1st Deb. Stk. Red.	100	101 —
27,507	5	4/6	Brompton & Kensington Elec. Supply Co., Ltd. Ord. ..	5	10¼—
12,493	5	3/6	Do. 7% Cum. Pref. Shares..	5	10½—
60,000	5	3/-	Calcutta Elec. Sup. Cor. Ltd., Ord .	5	9 —
£288,782	Stk	4%	Central Elec. Sup. Co., Ltd., 4% Gua. Deb. Stk. ..	100	105 —
70,000	5	4/-	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord... ..	5	8¼—
80,000	5	2/3	Do. do. 4½% Cum. Pref..	5	5½—
£350,000	Stk	4%	Do. do. 4% Deb. Stk. Red.	100	102 —
41,436	5	2/4	Chelsea Elec. Sply. Co., Ltd., Ord.	5	6¾—
£150,000	Stk	4½%	Do. do. 4½% Deb. Stk., Red	100	108 —
70,595	10	5/-	City of London El. Lghtg. Co., Ld., O	10	12¼—
40,000	10	6/-	Do. 6% Cum. Pref. . .	10	13¼—
£400,000	Stk	5%	Do. 5% Deb. Stk., Red ..	100	121 —
£300,000	Stk	4½%	Do. 4½% 2nd Deb. Stk., Red	100	102 —
40,000	10	4/-	County of London Elec Supply Co., Ltd., Ord.	10	9 —
30,000	10	6/-	Do. 6% Cum. Pref.	10	12 —
£400,000	Stk	4½%	Do. 4½% Deb. Stk., Red. ..	100	108 —
70,000	5	2/6	Edmundson's Elec. Cor. Ltd., Ord.	5	6¼ —
70,000	5	3/-	Do. 6% Cum. Pref.	5	6 —
£300,000	Stk	4½%	Do. 4½% 1st Mort. Db. Stk. Reg	100	106 —
£80,000	Stk	5%	Electric Lighting & Traction Co. of Australia, Ltd 5% Deb. Stk. Red.	100	86 —
10,000	5	2/-	Folkestone Elec. Supply Co., Ld., O	5	5½—
£50,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	101 —
15,000	10	—	Havana Electricity Co., Ltd... ..	10	9½—
13,000	5	3/6	Hove Elec. Lighting Co., Ltd., Ord	5	7¾—
£50,000	Stk	4½%	Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock, Red.	100	100—
150,000	1	—	Kalgoorlie Electric Power & Lighting Corp. Ltd., 6% Cum. Pref.	1	3/16—
21,000	5	5/-	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord. ..	5	13 —

ELECTRIC LIGHTING AND POWER.—*Contd.*

nt nt ibed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
000	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	102 —104
,000	3	—	London Elec. Supply Corp., Ld., Ord.	3	2⅜ — 2⅝
,000	5	3/-	Do. 6% Pref.	5	5¾ — 6
895	Stk	4%	Do. 4% 1st Mort. Db. Stk., Red.	100	96 — 98
,000	10	9/-	Metropolitan Elec. Sup. Co., Ld., Or.	10	18¼— 18¾
,121	5	2/3	Do. 4½% Cum. Pref.	5	5⅝ — 5¾
,000	Stk	4½%	Do. 4½% 1st Mort. Db. Sk., Red.	100	110 —115
,000	Stk	3½%	Do. 3½% Mort. Deb. Stk., Red.	100	96 — 98
000	—	4½%	Midland Elec. Corp. for Power Distribution, Ld., 4½% 1st Mort. Deb.	100	96 — 99
852	10	6/-	Notting Hill Elec. Ltg. Co. Ltd. Ord.	10	14½— 15
,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	102 —104
,500	5	2/6	Oxford Electric Co. Ltd., Ord. ..	5	6⅛— 6⅜
,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	98 —100
,700	100	4½%	Royal Elec. Co. (of Montreal) 4½% 20-yr. 1st Mort. Deb	100	100 —102
000	5	5/-	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	13¾—14¼
,000	5	3/6	Do. 7% Pref.	5	8½— 9
,000	Stk	3½%	Do. 3½% Deben. Stock, Red	100	98 —100
,000	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2¾— 3¼
000	Stk	4%	Do. 4% Debenture Stk Red.	100	82 — 86*
000	5	3/-	South London Elec. Sup. Co., Ltd. O.	5	4¼— 4½
,000	1	—	South Metropolitan Elec Light & Power Co., Ltd. Ord.	1	⅞ — 1
000	1	8⅜d.	Do. 7% Cum. Pref.	1	1⅜— 1 7/16
000	Stk	4½%	Do. 4½% 1st Deb. Stock Red.	100	107 —110
000	5	2/6	Urban Electric Supply Co., Ltd., O.	5	5 — 5½
000	5	2/6	Do. 5% Cum Pref.	5	5⅛— 5¼
,000	Stk	—	Do. 4½% 1st Mort. Deb. Stk. Red	100	105 —107
,000	5	6/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	13 — 13½
151	5	2/6	Do. 5% Cum. Pref.	5	6⅛— 6⅜

TELEGRAPH & TELEPHONE COMPANIES.

nt nt ibed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
,800	100	4%	African Direct Tel. Co., Ld., 4% Mt. Debs. (Series A), Red.	100	99 —102
,000	10	—	Amazon Telegraph Co., Ld... ..	10	1 — 1½
,580	Stk	17/6	Anglo-American Tel. Co., Ltd., Ord.	100	58 — 56*
210	Stk	35/-	Do. 6% Preferred Ordinary	100	103 —105*
210	Stk	2/-	Do. Deferred Ordinary ..	100	13¾— 14
000	5	3/-	Chili Telephone Co., Ltd.	5	6⅛— 6⅜
),000	$100	$2	Commercial Cable Co., Capital Stk.	$100	170 —190
856	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	95 — 97
000	10	5/-	Cuba Submarine Tel. Co., Ld., Ord.	10	8¾— 9¼
000	10	10/-	Do. 10% Preference	10	17 — 18
000	5	2/-	Direct Spanish Telegraph Co., Ord.	5	3⅜— 3⅝
		5/-	10% Cum. Preference	5	8 — 8½
000	50	4½%	Do. 4½% Debs...	50	100-102%
710	20	3/-	Direct U.S. Cable Co., Ltd... ..	20	11 —11½
800	100	4½%	Direct West India Cable Co., Ltd., 4½% Reg. Debs.	100	99 —101
000	100	4%	East. & S. African, Ld., 4% Mt. Db-.	100	100—102
000	25	4%	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)..	25	101-103%
000	10	2/6	Eastern Extension, Australasia and China, Ltd...	10	13½— 14
400	Stk	4%	Do. 4% Mort. Deb. Stk., Perp.	100	104 —106
000	Stk	25/-	Eastern Tele. Co., Ltd., Ord. ..	100	138 —141
000	Stk	17/6	Do. 3 % Pref.	100	88 — 90
814	Stk	4%	Do. 4% Mort. Deb.	100	105 —108
000	10	5/-	Great Northern Telegraph Co., Ltd., (of Copenhagen) ..	10	29¾— 30¼
700	100	4½%	Halifax and Bermudas Cable Co., Ltd., 4½% 1st. Mort. Debs. Red.	100	100—102
000	25	12/6	Indo-European Tele. Co., Ltd. ..	25	45½— 47½
380	1	7½d.	Monte Video Telephone Co., Ltd., O.	1	13/16— 15/16
333	Stk	6%	National Telephone Co., Ltd., Pref.	100	109 —110
367	Stk	5%	Do. Deferred	100	108—110
000	5	2/6	Do. 5% Non-Cum. 3rd Pref.	5	5¼ — 5½
000	Stk	3½%	Do. 3½% Deb. Stk., Red. ..	100	97 — 99
593	Stk	4%	Do. 4% do. do. ..	100	102 —104
313	1	7½d.	Oriental Telephone & Elec. Co., Ltd.	1	1 1/16— 1⅛
000	1	7½d.	Do. 6% Cum. Pref.	1	1 3/16 — 1 5/16
000	100	4%	Pacific & European Tel. 4% Guar. Debs. Red...	100	98 —101
339	8	4/-	Reuter's Telegram Co., Ltd. ..	8	7 — 7½
000	5	3/-	United River Plate Telep. Co., Ltd.	5	6¾— 7¼
000	5	2/6	Do. 5% Cum. Pref.	5	5 — 5¼
947	Stk	5%	Do. 5% Deb. Stock, Red. ..	100	105—107
309	10	4/-	W. African Telegraph Co., Ltd. ..	10	7¼— 7¾
008	2½	—	West Coast of America, Ltd. ..	2½	5/16— 7/16
000	100	4%	Do. 4% Deb. Guar. by West. Tel.	100	99 — 101

TELEGRAPHS AND TELEPHONES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name	Paid up.	Closing Prices.
88,321	10	6d.	W. India & Panama Teleg. Co., Ld., Or.	10	11/16— 13/16
34,563	10	6/-	Do. 6% Cum. 1st. Pref. ..	10	7¾— 8¼
4,669	10	6/-	Do. 6% Cum. 2nd Pref. ..	10	7¼— 7¾
£80,000	100	5%	Do. 5% Deb.	100	102 —104
207,930	10	3/-	Western Telegraph Co., Ltd. ..	10	13½— 14
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	101 —103
518,915	Stk	4%	Do. 4% Deb. Stock, Red. ..	100	102 —104

VI.—SHIPPING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
32,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 5½% Cum. Pref.	10	8½— 9
£325,000	Stk	4½%	Do. 4½% Red. 1st Mort. Deb. Stk.	100	99 —101
£672,900	Stk	4½%	British & African Stm. Nav. (1900) Ltd., 4½% 1st Mort. Deb. Stk. Red.	100	93 — 95
40, 000	10	5/6	Bucknall Steamship Lines, Ltd., 5½% Cum. Pref.	10	6 — 6½
£600,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk.	100	74 — 77
£750,000	Stk	4½%	Clan Line Steamers, Ltd., 4½% Deb. Stk. Red. ..	100	98 —100
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000..	20	13¾— 14¼
40,000	20	8/-	Do. Nos. 60,001-100,000	10	6 — 6½
£464,430	Stk	4½%	Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. ..	100	101 —103
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord...	1	1 3/16—1 5/16
25,328	7½	4/7	Gen. Steam Navigation Co., Ld., Ord.	7½	4¼— 4¾
36,758	8	4/9⅗	Do. Non-Cum. 6% Pref... ..	8	7¼— 7¾
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	97 — 99
55,000	5	1/3	Houlder Line, Ltd., Ord.	5	2¾— 3¼
40,000	5	2/9	Do. 5½% Cum. Pref.	5	3¼— 3¾
£200,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk. Red.	100	83 — 86
141,500	10	5/-	Leyland (Fredk.), & Co. (1900), Ltd., 5% Cum. Pref. ..	10	4½— 5
£1,160,000	Stk	5 %	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. ..	100	127 —130
£1,160,000	Stk	19%	Do. do. Deferred ..	100	220 —223
15,000	100	30/-	Royal Mail Steam Packet Co. Ord .	60	26 — 27
39,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref..	5	4¾— 5¼
39,075	5	2/6	Do. "B" Ord...	5	4 — 4½
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord..	10	8¼— 8¾
24,000	10	4/6	Do. 4½% Cum. Pref... ..	10	9¾— 10¼
£1,008,894	Stk	4%	Do. 4% Debenture Stk., Red.	100	99 —101

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
60 000	1	9⅜d.	Chadburn's (Ship) Tele. Ltd., Ord...	1	⅞— 1⅛
£750,000	Stk	5%	General Hydraulic Power Co., Ltd.	100	138 —143
12,500	10	10/-	Oakey (John) and Sons, Ltd., Ord..	10	24 — 26
10,000	10	6/-	Do. do. 6% Cum. Pf.	10	14 — 15
183,538	1	6·3d.	Power Gas Corp., Ltd., Ord., Nos. 66,463-250	15/-	5/16— 7/16
66,462	1	8·4d.	Do. do. Nos. 1 66,462	1	9/16— 11/16
135,000	1	6d.	Waygood (R.) & Co., Ltd., Ord. ..	1	1 1/16— 1 3/16
135,000	1	7½d.	Do. 6% Cum. Pref. ...	1	1⅛— 1¼

RAILWAY CARRIAGE & WAGON COMPANIES.

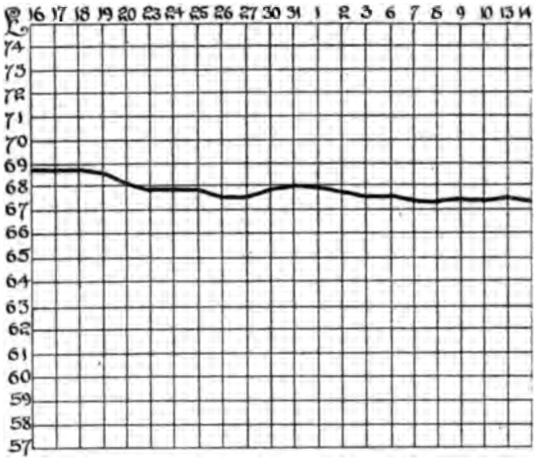
Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices
10,000	10	7/6	Birm. Railway-Car, & Wagon, L., 1-10,000	10	21½—
8,739	10	3/-	Do. Second Issue 1-8,739	4	8½— 9
10,000	10	6/-	Do. Cum. Pref. 6% 1-10,000..	10	13 — 13½
30,111	7	7/-	Gloucester Rail.-Car & Wagon, Ld., A, 1-29,861 & 49,751-50 000	7	9 — 9½*
44,889	7	3/6	Do. B, 29,862-49,750, 50,001-75,000	7	4 — 4½*
14,567	10	1/3	Lancashire Wagon, Ord. ..	2	2 7/16—2 9/16
4,150	10	5%	Do. do.	10	10⅝—10 13/16
784,808	1	9d.	Metropolitan Amalgamated Rail.-Carriage & Wagon, Ld., 1-784,808	1	42 —42/6
164,288	1	6d.	Do. Cum. A Pref. 5% 1-164,288	1	23/6—24/6
235,000	1	7½d.	Do. Cum. B Pref. 6% 1-235,000	1	28/—29/
20,000	20	20/-	Midland Rail.-Car. & Wagon, Ld., 1-20,000	10	19 —19½*

Stocks and Shares marked * are quoted ex-dividend.

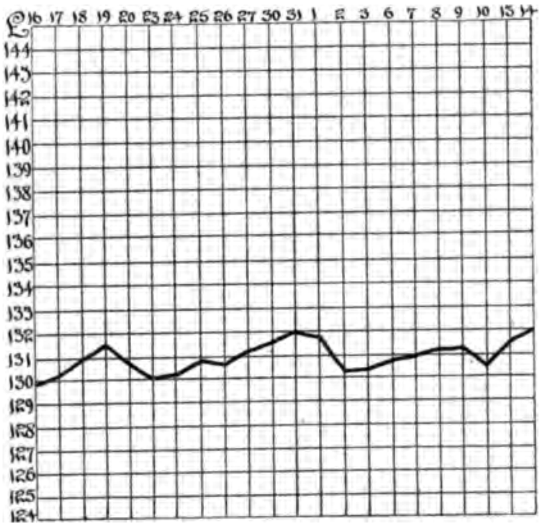
THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM JANUARY 16TH TO FEBRUARY 14TH, 1905.

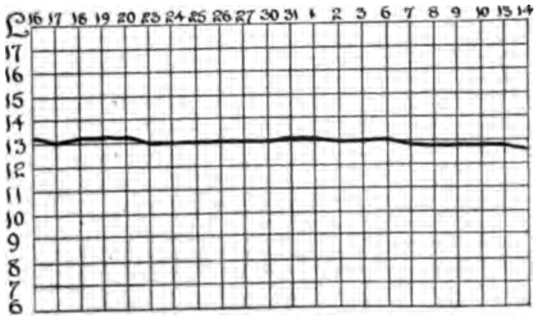
COPPER.



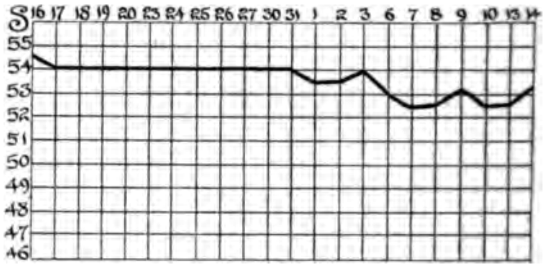
TIN.



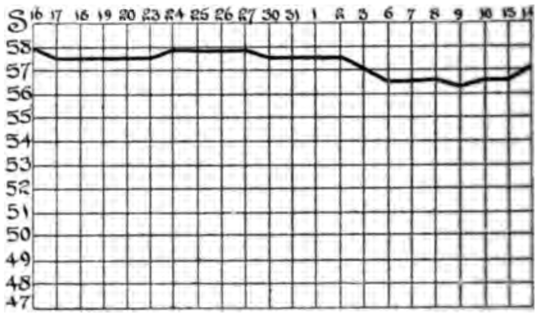
ENGLISH LEAD.



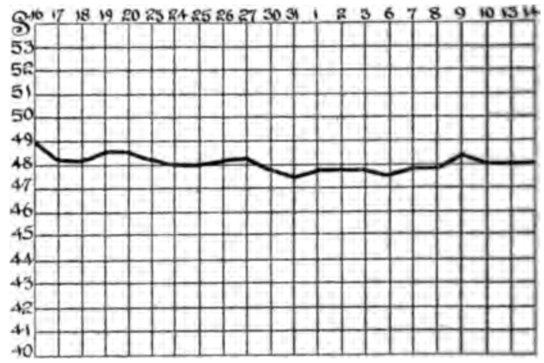
PIG IRON: SCOTCH,



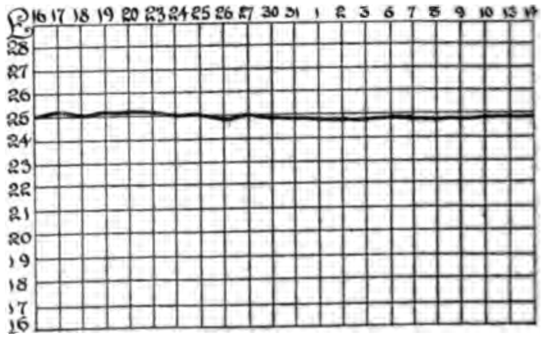
HEMATITE,



CLEVELAND.



SPELTER.



PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

MARKET REPORT.

Wednesday, February 15th, 1905.

COPPER has been weak and realisations by tired bulls were the prelude to some rather heavy selling. When it became clear, however, that the bears had been at work, the fall was arrested and covering operations on the part of the ursine brigade brought about a recovery. The tone however is not strong, and advices from the States show a quiet market there, although expert opinion still favours higher prices for copper in the immediate future. It is estimated that important quantities of metal have to be taken up by manufacturers at near dates, and that large orders for early delivery have still to be placed. The closing price is £67 10s. cash and £67 17s. 6d. three months.

Only small business is reported in Tin and quotations have fluctuated within narrow limits. The Eastern markets have been closed on account of Chinese holidays, and, as Messrs. Merton and Co. point out in their last circular, none of the prominent operators cared to give a lead. There is less demand from America, but the situation here is fairly sound, and with stocks being drawn upon to some extent Eastern dealers are holding off for better prices.

Lead, with a coincidence of heavy arrivals and a poor demand has been dull and as low as £12 10s. has been accepted both for prompt and forward delivery. Some slight recovery from this low quotation is now to be noted.

The Spelter market has hardened under the influence of the Belgian coal strike which is calculated to restrict supplies. At the moment demand is poor, and this has served to check the sharp rise which might otherwise have taken place.

In the Iron and Steel section activity is to be recorded in the speculative markets, and quotations have fluctuated sharply, with higher prices on balance. Cleveland has been as low as 47s. 5d. and as high as 49s. 1d., but the higher level brought out selling orders.

The industrial situation remains good. Advices from the States are distinctly encouraging, and the figures of production and consumption for January may be fairly described as remarkable. The output has been large, but stocks have been again drawn upon. The reports of correspondents from our own trade centre are still cast in a hopeful strain.

IRON, STEEL, PIG-IRON, &c.

SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as follows. Prices delivered in Glasgow or equal :—

	£	s.	d.
Steel :			
Siemens' Steel Plates, Marine Boiler Quality	6	15	0
,, ,, ,, Land ,, ,,	6	17	6
,, ,, ,, Ship Quality Plates	5	17	6
Siemens' Steel Bars, Boiler Quality	6	17	6
,, ,, ,, Ship ,,	6	7	6
,, ,, Angles	5	7	6
Manufactured Iron :			
Bars—Dalzell	6	2	6
,, Best	6	12	6
,, ,, Horseshoe	6	12	6
,, Angle	6	2	6
,, Best Angle	6	12	6
,, Best Best	7	2	6
,, Extra Best	7	12	6

Usual terms and extras. Special rates for delivery in England and export. The above prices subject to alteration without notice.

The Glasgow Iron and Steel Co., Ltd., Wishaw, quote as under (prices are delivered Glasgow or equal) :—

	£	s.	d.	
Steel Angles (Glasgow ♛ Steel)	5	7	6	per ton.
Steel Ship Plates (Glasgow ♛ Steel)	5	17	6	,,
Steel Bars, Ship Quality (Glasgow ♛ Steel)	6	7	6	,,
Steel Bars, Boiler Quality (Glasgow ♛ ♛ Steel)	6	17	6	,,
Steel Land Boiler Plates (Glasgow ♛ ♛ Steel)	6	7	6	,,
Steel Marine Boiler Plates (Glasgow ♛ ♛ Steel)	6	7	6	,,

Less 5 per cent. discount. Extras as per standard list.

Special prices for delivery in England and for export. The above prices subject to alteration without notice.

John Spencer (Coatbridge), Ltd., Phœnix Ironworks, Coatbridge, N.B., quotes :—

	£	s.	d.
Bars—Phœnix	6	5	0
,, Best	6	15	0
,, Best Best	7	5	0
,, Extra Best	7	15	0
,, Best Horse Shoe	6	15	0
,, Extra B.H.S.	7	15	0
,, Extra Best Cable	8	5	0
,, Rivet	6	5	0
,, Best Scrap Rivet	7	5	0

	£	s.	d.
Angles—Phœnix	6	5	0
,, Best	6	15	0
,, Extra Best	7	5	0
Gas Tube Hoops—Phœnix Best	6	15	0
Plates—Phœnix	—		
,, Best Boiler	7	10	0
,, Best Best Boiler	8	0	0
,, Extra Best Boiler	9	0	0
Boiler Tube Strips—Phœnix Best Best	8	0	0

All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly.

Messrs. R. Feldtmann and Co., of Glasgow, quote Commission extra).

Pig Iron:	No. 1.			No. 3.		
	£	s.	d.	£	s.	d.
Coltness, f.a.s. Glasgow	3	5	0	2	15	0
Gartsherrie ,,	2	19	0	2	13	6
Summerlee ,,	3	0	6	2	15	0
Carnbroe ,,	2	16	6	2	12	6
Langloan ,,	3	4	0	2	15	0
Calder ,,	2	19	0	2	13	6
Clyde ,,	2	18	6	2	13	6
Glengarnock, f.o.b. Ardrossan	2	19	0	2	12	6
Eglinton ,, ,,	2	14	6	2	12	6
Dalmellington, ,, Ayr	2	14	6	2	12	6
Shotts ,, Leith	2	19	0	2	14	6

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, **at works:—**

	£	s.	d.
W.W. Bars	6	12	6
W.W. Best Bars	7	2	6
W.W. Best Best	7	12	6
W.W. Best Best Best	8	2	6
W.W. Best Shoe	7	2	6
Thornaby	8	2	6
Thornaby Best	8	12	6
Thornaby Best Best	9	12	6
Whitwell Special Admiralty Cable	10	5	0
Special Chain Iron	9	5	0
Tube and Nail Strips	6	15	0
W.W. Angle Iron	6	15	0
W.W. Best Angle Iron	7	5	0
Tee Iron, to 8-inches United	7	12	6

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington, quote:—

	Iron.			Steel.		
	£	s	d.	£	s.	d.
(8F) Bars	6	10	0	7	5	0
,, ,, Angles	7	0	0	7	5	0
,, ,, Tees	7	10	0	7	15	0
WIW Hoops	7	0	0	7	10	0
,, ,, Sheets	7	10	0	8	0	0

Ordinary Sizes, F.A.S. Liverpool in 10-ton Lots.
Extras for Sizes and Cutting as per List.

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

	Singles 20 G 96in. by 36in. per ton.			Doubles 21 G to 24 G 96in. by 36in. per ton.		
Black Sheets:	£	s.	d.	£	s.	d.
"Vale"	10	0	0	10	10	0
"Shield"	10	10	0	11	10	0
"Severn"	11	10	0	12	10	0
"Baldwin Wilden B."	12	10	0	13	10	0
Charcoal	16	10	0	17	10	0
Best Charcoal	18	10	0	19	10	0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:	£	s.	d.	£	s.	d.
No. 3 Lead	13	10	0	14	10	0
S.V. Lead	15	0	0	16	0	0
No. 3 Terne	15	0	0	16	0	0
S.V. Terne	16	10	0	17	10	0

	Singles 20 G to 108 by 36in. per ton.			Doubles 21 to 24 G to 96 by 36in. per ton.		
Tinned Sheets:	£	s.	d.	£	s.	d.
Best Coke (Finish)	28	0	0	29	10	0
,, Charcoal (Finish)	30	0	0	31	10	0
Extra ,, ,,	32	0	0	33	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.

Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box.

Extreme sizes in Tin and Patent Coated specially quoted for.

Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.

At works less 2½% for cash monthly, 10th inst.

Galvanized Corrugated Sheets:

	£	s.	d.	
"Phœnix" Brand, 24 G., f.o.b. London, in Bundles	11	15	0	per ton.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	14	7	6	,,

Galvanized Working Up-Sheets:

	£	s.	d.	
24 G., f.o.b. London, in Bundles	13	15	0	per ton.

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£	s.	d.	
Crown Bars	6	10	0	per ton.
Best Bars (1 to 6in. wide, above ¼ in. thick, ½ in. to 4 rounds and squares)	7	0	0	,,
Angles	6	15	0	,,
,, Best	7	5	0	,,
T's	7	0	0	
,, Best				
Best Shoe Iron				
,, Rivet Iron				
,, Best Rivet (Special)				
,, Cable				
,, Screwing				

	£	s.	d.	
Best Turning	8	0	0	per ton.
,, Plating	8	5	0	,,
,, ,, Best Best	9	5	0	,,
,, ,, Treble	10	5	0	,,
Plates	7	10	0	,,
Best Plates	8	0	0	,,
,, Boiler Plates	8	10	0	,,
,, Best Boiler Plates	9	10	0	,,
Treble Best Boiler Plates	12	0	0	,,

elivery f.o.b. Liverpool, Birkenhead or Manchester.

WALES.

ordes (Dos Works), Ltd., of Newport, Mon., te "Star" brand patent wrought nails, steel nails, &c.

Discounts—

5 per cent. off 1-inch to 3-inch strong rose and all fine rose and . and 8dy. pound.
0 per cent. off 3½ inch to 7-inch strong rose and 10dy. and y. pound.
0 per cent. off all sharp-pointed nails.
elivered in lots of 4 cwt. and upwards. Extra 2½ per cent. ount off the gross on two tons and upwards.
teel rose, flat points, 5-inch to 7-inch basis :—
ons 9/6 per cwt. } d/d any Railway Station.
wt. lots and upwards 9/9 per cwt. }

teel cut nails, 3-inch basis—
2 tons 8/3 per cwt. } d/d any Railway Station.
4 cwt. lots 8/6 per cwt. }
lit rods (iron) £7 10s. per ton, at works for 2-ton lots.

essrs. Richard Thomas and Co., Ltd., of and 35, Eastcheap, E. C. — Works: South ales, Burry, Lydney, Lydbrook, and Cwmbwrla, te :—

ke Tin-plates.	Per Box. f.o.b. Wales. £	s.	d.
C 18¾ by 14 124s. 110 lb. "BV"	0	12	10½
C 20 by 10 225s. 155 ,, "Jumbo"	0	18	0
C 20 by 14 112s. 108 ,, "Lydbrook"	0	12	4
C 28 by 20 112s. 216 ,, "Lydbrook"	1	5	0

arcoal Tinplates :

	£	s.	d.
C 20 by 14 112s. 108 lb. "Allaway"	0	13	1½

BELGIUM.

. L. Faulkner, Suffolk House, Laurence untney Hill, London, E.C., quotes :—

rices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) ivered free on board ANTWERP for approved quantities.

eel :

		£	s.	d	
Blooms	at	3	12	0	per ton.
Billets	at	3	14	0	,,
Sheet Bars	at	3	16	0	,,

nished Steel :

		£	s.	d	
Bars	at	5	0	0	per ton.
Angles	at	5	1	0	,,
Tees	at	5	4	0	,,
Joists	at	4	10	0	,,
Fencing Standards	at	5	2	0	,,
Shoeing Bars	at	5	4	0	,,
Tyre Bars	at	5	4	0	,,
Half-Round Bars	at	5	5	0	,,
Heavy Rails	at	4	15	0	,,
Light Rails	at	4	17	6	,,

ructural Steelwork :

Prices on application.

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote :—

TIN.

Tin :	£	s.	d.		£	s.	d.	
English Ingots, f.o.b. Dis. 1½% & 1%	132	0	0	to	132	10	0	per ton.
English Bars, f.o.b. Dis. 1½% & 1%	133	0	0	to	133	10	0	,,
Straits G.M.B., cash Warehouse, Net	131	17	6	to	132	0	0	,,
Straits G.M.B., 3 months, Warehouse, Net	130	5	0	to	130	10	0	,,
Australian, Mr. Bischoff, Warehouse, Net	132	10	0	to	132	15	0	,,

COPPER.

Copper :	£	s.	d.		£	s.	d.	
Standard G.M.B., cash Warehouse, Net	67	7	6	to	67	10	0	per ton.
Standard G.M.B., 3 months, Warehouse, Net	67	15	0	to	67	17	6	,,
English, Tough, Cake & Ingot, Warehouses, Net	70	0	0	to	70	10	0	,,
English, Best Select, Warehouse Net	70	10	0	to	71	0	0	,,
English, Sheets and Sheathing, f.o.b., Dis. 2½%	80	0	0	to	80	10	0	,,
English, Sheets for India, f.o.b., Dis. 2½%	76	0	0	to	76	10	0	,,
Electro, Warehouse, Net	7015		0	to	71	0	0	,,
Ore, ex. ship	0	12	0	to	0	13	0	per unit.
Regulus, Matte and Precipitate, ex. ship,	0	13	3	to	0	14	0	,,

YELLOW METAL.

Yellow Metal :	£	s.	d.	£	s.	d.	
Sheets, 4 by 4 feet for India f.o.b. Dis. 2½%				0	0	6¾	per lb.
Sheathing ,, ,,				0	0	6⅞	,,

SPELTER.

	£	s.	d.		£	s.	d.	
Silesian outports, Net	24	15	0	to	25	0	0	per ton.
Blende of 50 % Net	6	16	6	to	7	0	0	,,
Calamine, Net	6	19	0	to	7	0	0	,,

LEAD.

	£	s.	d.		£	s.	d.	
English Pig, Warehouse, Dis. 2½%	12	15	0	to	12	17	6	per ton.
Spanish, ex ship, Dis. 2½%	12	10	0	to	12	12	6	,,
Lead Ore of 70 %, Net	6	10	0	to	6	12	6	,,

ANTIMONY.

	£	s.	d.		£	s.	d.	
Star Regulus, f.o.b., Dis. 2½ %	36	0	0	to	37	0	0	per ton.
Ore, 50 %, ex ship, Dis. 2½%	8	10	0	to	9	10	0	,,
Crude, ex ship, Dis. 2½ %	13	10	0	to	14	0	0	,,

QUICKSILVER.

	£	s.	d.	
Spanish, 75 lb., Warehouse, Net	7	12	6	per flask.
Italian ,, ,, ,,	7	11	6	,,

COAL.

LEICESTERSHIRE.

The Nailstone Colliery Company, Leicester, quote. Price per Ton at Pit of 20 Cwt., with ½ Cwt. per Ton for wastage —

Upper Main Seam.	s.	d.
Main Coal	7	6
Best Hard Steam (hand picked, as used by the Railway Companies)	6	0
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)	6	0
Fine Slack	0	6

Terms, net cash on 10th of month following delivery.

DERBYSHIRE.

The Manners Colliery Co., Ltd., of Ilkeston quote as follows, per ton at pit:

Kilburn Coal:	s.	d.
Best London Brights	9	9
Large Nuts (1½ to 3½)	9	6
Small Nuts (¾ to 1½)	6	0
Rough Brights	6	0
Peas (⅜ to ¾)	5	0
Slack	3	6
Smudge	2	0

Low Main (or Tupton) Coal:	s.	d.
Low Main Brights	7	6
,, ,, Nuts	7	3
Hards (Good Steam Coal)	8	0
Bakers' Nuts (1" to 2")	6	6
Slack	3	6

The Clay Cross Company's Collieries, Clay Cross, near Chesterfield, quote:—

	per ton at pit. s.	d.
Best Main Coal	10	6
Best Silkstone	10	0
Best House Coal	8	6
Best House Nuts	8	0
Treble Screened Cobbles	7	9
Best Cobbles	7	3

NOTTINGHAMSHIRE.

The Digby Colliery Co., Ltd., near Nottingham, quote per ton at pit:—

Digby Coal:

STEAM.	s.	d.
Best Hand Picked Hard	9	0
Steam Hard	7	9
Hard Nuts	7	0

Gedling Colliery.

HIGH HAZEL.	s.	d.
London Brights, 4 to 8 in. cube	12	0
Large Nuts, 2 to 4 in. cube	9	6
Small Nuts, ¾ to 2 in. cube	5	6

STEAM.—TOP HARD.	s.	d.
Best Hard	9	0
Hard Steam	8	0
Cobbles	7	0

CHEMICALS AND OILS.

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square, Manchester, quote:

		£	s.	d.	
Acids:	Oxalic	0	0	2⅜	per lb.
	Picric, Crystals	0	0	11	,,
	Tartaric ... at Manchester	0	0	10⅞	,,

		£	s.	d.	
Acetate of Lime:	Brown at Manchester net	9	10	0	per ton.
	Grey ,,	11	10	0	,,
Alumina:	Alum, Lump, loose	5	5	0	,,
	,, ,, in casks	5	7	6	,,
	,, Ground, in bags	5	15	0	,,
	Sulphate of Alumina, 14%	4	10	0	,,
Ammonia:	Carbonate	0	0	3⅝	per lb.
	Muriate Grey f.o.b. Liverpool	24	0	0	per ton.
	Sal-ammoniac, Lump, 1sts, deld. U.K.	42	0	0	,,
	,, ,, 2nds, ,,	40	0	0	,,
	Sulphate ... f.o.b. Liverpool	13	5	0	,,
Arsenic:	Best White Powdered ... net	12	5	0	,,
Bleaching Powder,	35% ... ,,	4	10	0	,,
Borax:	British Refined Crystal ... ,,	12	0	0	,,

Coal Tar Products:		£	s.	d.	
Benzole, 50/90 %	,,	0	0	8¼	per gal.
,, 90%	,,	0	0	10	,,
Carbolic Acid Crystals, 34/35° C. ...	,,	0	0	6⅞	per lb.
,, ,, ,, 39/40° C. ...	,,	0	0	7⅜	,,
,, ,, Liquid, 97/99 % ...	,,	0	0	9	per gal.
,, ,, Crude, 62½% at 60° F. f.o.b.	,,	0	2	0	,,
Creosote, ordinary good liquid	,,	0	0	1¼	,,
Naphtha, Crude, 20 % at 120° C. ...	,,	0	0	3	,,
,, Solvent, 90% at 160° C. f.o.b	,,	0	0	8⅜	,,
,, ,, 95 % at 160° C. ,,	,,	0	0	9⅜	,,
,, ,, 90 % at 190° C. ,,	,,	0	0	10⅞	,,
,, Rectified, flash point over 73° F. ... f.o.b.	,,	0	0	11	,,
,, Rectified, flash point over 100° F. ... f.o.b.	,,		1	0	,,
Naphthalene, all qualities.					
Pitch ... f.a.s. Manchester.	,,	1	12	0	per ton.
Copperas: Green, in bulk	,,	0	12	6	,,
,, barrels f.o.b. L'pool	,,	1	19	0	,,
Cake	,,	1	2	6	,,
Copper: Sulphate		22	15	0	,,
Cyanides: 98% minimum ... f.o.b.	net	0	0	8	per lb.

		£	s.	d.	
Lead:	Acetate (Sugar) White. English	27	10	0	per ton.
	,, ,, ,, Foreign c.i.f. U.K	24	5	0	,,
	,, ,, Grey	21	15	0	,,
	,, ,, Brown at Manchester	17	0	0	,,
	Nitrate	24	0	0	,,
	Litharge, Flake	15	10	0	,,
	,, Powder	16	0	0	,,
	Red Lead, Genuine, c.i.f. London less 5%	15	10	0	,,
	White ,, ,, Dry ,, ,, ,,	16	15	0	,,
Naphtha (Wood):	Miscible, 60 o.p.	0	2	10	per gal.
	Solvent	0	2	7	,,
Potash:	Bichromate... delivered England...	0	0	3	per lb.
	Carbonate, 90/92 % ... c.i.f Hull ...	18	0	0	per ton.
	Caustic, 75/80 % ... ,, ,, ...	20	10	0	,,
	Chlorate ... net	0	0	3 1/16	per lb
	Montreal ... in Store, Liverpool	35	0	0	per ton.
	Prussiate, Yellow ... net	0	0	5	per lb.

	£	s.	d.	
a: Ash, Caustic, 48 %, Ordinary ... ,,	5	5	0	per ton.
,, ,, ,, Refined...... ,,	6	5	0	,,
,, Carbonated, 48 %............ ,,	5	10	0	,,
,, ,, 58 % (Ammonia Alkali) ....net	4	10	0	,,
,, Bleachers' Refined Caustic 50/52 % .... net	6	10	0	,,
Caustic, White, 77 %............... ,,	10	10	0	,,
,, ,, 70 %............... ,,	9	12	6	,,
,, ,, 60 %............... ,,	8	12	6	,,
,, Cream, 60 %..... .... ,,	8	10	0	,,
Crystals, in bags	3	0	0	,,
,, barrels	3	7	6	,,
Acetate .... c.i.f. Hull net	16	10	0	,,
Bicarbonate, in 1 cwt. kegs...........	6	15	0	,,
Bichromate......delivered England...	0	0	2¼	per lb.
Chlorate .... net	0	0	3 1/16	per lb.
Nitrate...ex quay Liverpool, ... ,,	11	7	6	per ton.
Phosphate	9	5	0	,,
Prussiate ....net	0	0	3⅜	per lb.
Silicate, Solution, 140° Tw.	4	10	0	per ton.
Sulphate (Glauber Salts)...............	1	12	6	,,
,, (Saltcake, 95%)..............	1	15	0	,,
hur: Recovered	4	15	0	,,
Roll	6	15	0	,,
Flowers..................................	7	10	0	,,
: Sulphate	6	15	0	,,

MINERALS.

	£	s.	d.	
ytes: Lump Carbonate, 90/92%	3	10	0	per ton.
Sulphate, No. 1, White	2	15	0	,,
a Clay: of various qualities for all purposes; prices from about 11/- to about 30/- per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid.				
ome Ore: Basis 50% c.i.f. British Ports..........	3	7	6	,,
ganese: Lump c.i.f. Liverpool 10¼d.	per metallic unit.			
re: French JC .... f.o.b. Rouen, net	2	5	0	per ton.
,, JF	5	10	0	,,
: (French Chalk).........c.i.f. Liverpool	3	10	0	,,

OILS, etc.

	£	s.	d.	
ine Oil ....net	0	0	4⅜	per lb.
, Salt.......... .... ,,	0	0	4½	,,
or Oil: French, 1st pressure, f.o.b. Marseilles less 1½%.........	22	5	0	per ton.
English, 1st pressure, f.o.r. Hull, less 2½%...............	23	10	0	,,
a Nut Oil: Ceylon, ex store Manchester...............net	29	10	0	,,
Cochin, ex store Manchester.. ....net	32	0	0	,,
on Seed Oil: Refined at Hull, less 2½% naked	13	7	6	,,
Edible...at Hull, less 2½% naked	13	17	6	,,
erine: Crude, 80% .... net	31	0	0	,,
eed Oil: Raw... ..at Hull, less 2½% naked	13	2	6	,,
Boiled......at Hull less 2½% naked	14	2	6	,,
ch: American Pearl...at Manchester, net	9	0	0	,,
Dextrine............ ,, ,,	18	0	0	,,
Farina............... ,, ,,	15	15	0	,,
llac: Standard TN orange spot	140/-			per cwt.
pentine: American.........at Liverpool	38	10	0	per ton.
Russian ....at Hull...net	19	0		,,

TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote :—

COLONIAL WOODS.

Timber.

		£	s.	d.		£	s.	d.
Quebec Square White Pine...	per cub. ft.	0	1	9	to	0	3	0
Quebec Waney Board Pine...	,,	0	2	8		0	3	9
St. John Pine, 18 in. average	,,	0	2	4		0	3	3
Lower Ports Pine................	,,	0	1	3		0	1	8
Quebec Red Pine	,,	0	1	6		0	2	0
Quebec Oak, 1st quality	,,	0	2	9		0	3	4
Quebec Oak, 2nd quality ...	,,	0	1	6		0	2	6
Ash	,,	0	1	6		0	2	3
Elm	,,	0	3	3		0	3	10
Hickory	,,	0	2	0		0	2	6
Quebec Birch	,,	0	1	6		0	2	3
St. John Birch	,,	0	1	6		0	2	0
Birch Planks.....................	,,	0	0	9		0	0	11
Spruce Spars	,,	0	0	10		0	1	0

Deals.

		£	s.	d.		£	s.	d.
1st quality Quebec Pine	per std.	22	10	0	to	32	10	0
2nd do. do.	,,	17	0	0		22	0	0
3rd do. do	,,	11	10	0		13	0	0
St. John, N.B., etc., Spruce	,,	6	15	0		7	5	0
Lower Ports Spruce..	,,	6	10	0		6	15	0
Spruce Boards.................	,,	5	10	0		6	0	0

UNITED STATES, etc., WOODS.

Pitch Pine.

		£	s.	d.		£	s.	d.
Hewn	per cub. ft.	0	1	4	to	0	1	8
Sawn	,,	0	0	11		0	1	6
Planks, Stowage	,,	0	0	10		0	1	0
Boards, Prime	per std.	12	10	0		16	0	0
Oak Timber	per cub. ft.	0	1	6		0	2	6
Oak Planks	,,	0	1	6		0	2	1
East India Teak..............	per load	12	0	0		16	0	0
Greenheart.....	,,	6	15	0		7	10	0

EUROPEAN WOODS.

Timber.

		£	s.	d.		£	s.	d.
Riga Redwood	per cub. ft.	0	1	6	to	0	2	0
Dantzic and Memel Fir, Crown	,,	0	2	1		0	2	6
Dantzic and Memel Fir, Middling	,,	0	1	9		0	1	11
Stettin	,,	0	1	9		0	1	11
Swedish	,,	0	1	0		0	1	3
Riga Whitewood	,,	0	1	0		0	1	3
Norway Mining Timber	,,	0	0	9		0	1	0
Dantzic and Stettin, etc., Oak..	,,	0	2	6		0	3	0
Norway Spars.................	,,	0	1	2		0	1	9

Deals.

		£	s.	d.		£	s.	d.
Red Archangel and Onega, 1st quality	per std.	19	0	0		20	0	0
Red Archangel and Onega, 2nd quality	,,	14	0	0		16	0	0
Red Archangel and Onega, 3rd quality	,,	10	10	0		12	10	0
St. Petersburg, 1st quality...	,,	16	0	0		17	10	0
Do. 2nd ,, ...	,,	14	0	0		15	0	0
Gefle	,,	11	10	0		16	0	0
Wyburg	,,	11	0	0		12	10	6
Uleaborg	,,	10	0	0		12	10	0
Gothenburg	,,	11	0	0		16	0	0

SELECTED PATENTS.

Compiled expressly for this journal by **Messrs. Page and Rowlingson, Engineering Patent Agents, 28, New Bridge Street, London, E.C.,** and at Manchester.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton Buildings, Chancery Lane, W.C., at the uniform price of 8d.

NEW PATENTS APPLIED FOR.

When Patents have been communicated the names of the communicators are printed in italics.

1904.

288743a. A. E. Stove, London. Feb. 1st.—Means for securing hose couplings to hydrants, fire cocks, and the like. (Date applied for, Dec. 29th, 1904.)

1905.

1761. S. H. Adams, Scotswood-on-Tyne. Jan. 30th.—Improvements in pen-stocks and sluices.

1770. J. Kirkman, Chorley, Lancs. Jan. 30th.—Improvements in the manufacture of packing for the stuffing-boxes of steam-engine piston rods, and for other similar joints requiring to be steam, air, or water tight.

1772. A. C. Lee, Slough. Jan. 30th.—An automatic fog signal (detonator) placing and displacing machines for railway use.

1780. J. Gregory, Lincoln. Jan. 30th.—Improved method of fog signalling on railways and other places or stations.

1788. O. Blankmeister, London. Jan. 30th.—Improvements in the production of reels of leaf metal.

1794. C. A. Hunton and G. R. Phipps, London. Jan. 30th.—Improvements in shifting spanners, wrenches, and the like.

1805. J. C. Merryweather, London. Jan. 30th.—Automobile fire engine.

1806. A. Spies G. m.b.H., London. Jan. 30—Improvements in apparatus for weighing railway vehicles. (Date applied for, Mar. 12th, 1904.)

1807. Fried. Krupp Akt.-Ges., London. Jan. 30th.—Improvements in sighting attachments for ordnance. (Date applied for, Mar. 12th, 1904.)

1808. J. Carlu, London. Jan. 30th.—An improved appliance for cleaning and lubricating chains.

1814. J. Brundrit, London. Jan. 30th.—Improvements in elastic fluid turbines.

1824. F. W. Howorth, London. Jan. 30th.—Improvements in edge runners and moulding presses. (*Bühler Bros., Switzerland.*)

1825. G. Simpson, London. Jan. 30th.—Improvements in submarine vessels and mechanism connected therewith.

1830. The Warwick Machinery Co., Ltd., and K. Ahlquist, London. Jan. 30th.—Improvements in bucket construction for steam turbines.

1834.—H. S. Walford, London. Jan. 30.—Improvements in and relating to the steering gear of boats, launches, and vessels. (*C. E. Fairlie, South Africa.*)

1848. F. B. Hart, Stockport. Jan. 31.—Improvements in railway signalling.

1854. A. Smallwood, Birmingham. Jan. 31st.—Improvements in and relating to furnaces for annealing and the like purposes.

1855. A. Smallwood, Birmingham. Jan. 31st.—Improvements in the means for generating and applying heat in steam boilers of the Lancashire, Cornish, or other similar type.

1860. A. A. Blackburn and H. Wernon, Manchester. Jan. 31st.—Improvements in workshop trolleys.

1866. A. S. Nelson, London. Jan. 31st.—Maximum traction truck.

1872. J. T. Stewart, Oxford. Jan. 31st.—Steam superheaters.

1873. H. P. Young, Birmingham. Jan. 31st.—Improvements in the means of propelling steamships or the like.

1903. C. A. H. Bartelt, London. Jan. 31st.—Improvements in or relating to steam generators.

1907. L. Hachenburg, E. Sandford, and L. Sandford, London. Jan. 31st.—Improvements in turbine engines

1918. J. H. Petterson and C. H. Rawson, London. Jan. 31st.—Improvements in rotary engines.

1922. N. Johnson, London. Jan. 31st.—Improvements in apparatus for cutting or excavating trenches.

1925. The British Thomson-Houston Co., Ltd., London. Jan. 31st.—Improvements in valve mechanism. (*The General Electric Co., U.S.A.*).

1927. The British Thomson-Houston Co., Ltd., London. Jan. 31st.—Improvements in and relating to shaft bearings and supports therefor. (*The General Electric Co., U.S.A.*).

1941. D. D. Danziger, London. Jan. 31st.—Improved white metallic alloy.

1962. G. Jackman, Johnstone. Feb. 1st.—Improvements in and connected with bar working lathes.

1967. W. D. A. Bost, Glasgow. Feb. 1st.—Improvements in steam generators.

1978. A. E. Tucker and C. T. Crowden, Birmingham. Feb. 1st.—Improvements in motive power engines.

1983. J. Cowle, Peebles, N.B. Feb. 1st.—Improved combined air and internal combustion engine.

1986. A. Barraclough, Heckmondwike. Feb. 1st.—Improvements in cocks and valves for water supply.

1988. A. E. Tucker and C. T. Crowden, Birmingham. Feb. 1st.—Improvements in motive power engines.

1990. J. E. Slack, Heaton Chapel. Feb. 1st.—Sectional water-tube boiler.

2006. J. Stevens, London. Feb. 1st.—Improvements in or relating to hydraulic presses, more especially designed for pressing metalliferous ore briquettes.

2007. H. T. Jones and J. P. Ludeman, London. Feb. 1st.—An improved blower or continuous air pump.

2010. G. Miettinen, London. Feb. 1st.—Improvements in rotary engines or turbines.

2023. H. E. Brown, London. Feb. 1st.—Improvements relating to brake mechanism for railway and other vehicles.

2028. R. A. Carter, London. Feb. 1st.—Improvements in apparatus for bending metal rods or the like.

2041. Palmer's Shipbuilding and Iron Co., Ltd., and R. J. Webster, London. Feb. 1st.—Improvements in rivet-making machines.

2051. J. Leckiep, Glasgow. Feb. 2nd.—Improvements in and relating to machinery for the manufacture of copper, brass, and like, metal pipes and tubes.

2054. P. E. Dowson, Manchester. Feb. 2nd.—Improvements in packing for glands or stuffing boxes for piston rods and the like.

2055. J. E. Davies, Bristol. Feb. 2nd.—A stand for ratchet machines for rock and coal boring.

2058. E. C. Browning, Southampton. Feb. 2nd. Improvements in or relating to screw bolts and nuts.

2061. Babcock and Wilcox, Ltd., R. A. McLaren, H. W. Kolle, and A. E. Parker, London. Feb. 2nd—Improvements in chain brake stokers.

2087. W. H. Scotton, London. Feb. 2nd.—Improvements in or relating to internal combustion engines.

2103. F. C. Ihlee, London. Feb. 2nd.—Improvements in or relating to internal combustion engines.

2115. The British Thomson-Houston Co., Ltd., London. Feb. 2nd.—Improvements in valve mechanism. (*The General Electric Co., U.S.A.*).

2126. R. P. R. Embury, Birmingham. Feb. 3rd.—Improvements in and relating to spanners and wrenches for the turning of certain kinds of nuts, bolts, and such like.

2127. H. Campbell, Halifax. Feb. 3rd.—Improvements in internal combustion engines.

2128. J. Hargreaves, jun., Manchester. Feb. 3rd.—Improvements in steam traps.

2135. W. M. Roberts, Glasgow. Feb. 3rd.—Improvements in steam turbines.

2164. A, Fodor and N. de Szemere, London. Feb. 3rd.—Improvements in railway car couplings.

2165. J. H. Morgan and P. B. Massey, Leeds. Feb. 3rd.—An improvement in spanners.

2184. W. H. Slatter, London. Feb. 3rd.—An invention or appliance to prevent railway trains, engines, or other rolling stock from jumping or leaving lines while going round a curve or elsewhere.

2191. A. Waibl, London. Feb. 3rd.—Improvements in water-gauges for steam boilers and the like.

2195. W. J. Reid, E. F. Reid, M. F. Reid, and I. Reid, London. Feb. 3rd.—Improvements in devices for self-lubrication of sheaves, pulleys, and other wheels designed for rotation on shafts or axles and bearings for reception of rotary shafts and axles.

2208. J. H. Godman, St. Albans. Feb. 4.—Improvements in internal combustion engines.

2219. A. O. Hamilton, Dundee. Feb. 4.—Improved compound or composition for removing scale from boilers.

2225. J. M. Fleming, Glasgow. Feb. 4th.—Self-propelling traction wagons.

2227. W. L. Jackson, Glasgow. Feb. 4th.—Improvements in machines for tunnelling and (or) cutting earth, rocks, and such like.

2243. A. F. Evans, London. Feb. 4th.—Improvements in oil engines.

2257. I. A. Timmis, London. Feb. 4th.—Improvements in the construction of bogie cars that run on rails.

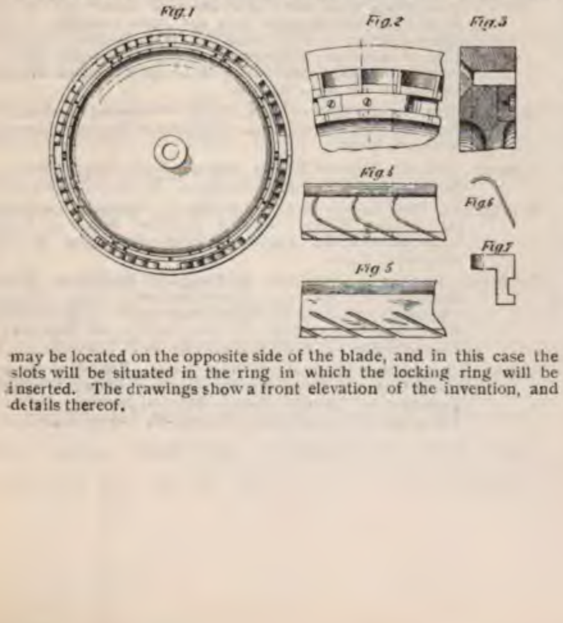
RECENT SPECIFICATIONS.

METAL AND ALLOYS.

Marquis Albert de Dion and Georges Bouton, of Seine, France. June 17th, 1904. (Date claimed under the International Convention.)—This invention relates to an improved process in the manufacture of nickel steel,. The process consists in the addition of silicon in the proportion of from 2% to 5% to pearlitic steel, and from 3 % to 5 % to martensitic steel. This process, while retaining the pearlitic and martensitic structures respectively, greatly increases the breaking load, and the elastic limit which the products will bear, while the contraction of area, elongation and resistance to impact are slightly increased.

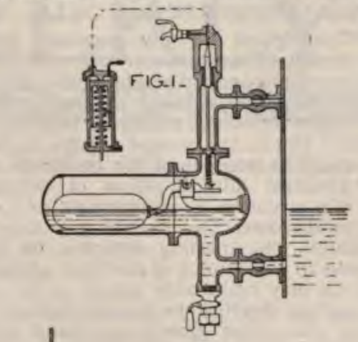
ELASTIC FLUID TURBINES.

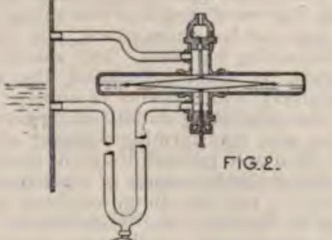
Howorth (Communication from Actiengesellschaft Der Maschinefabriken Von Escher Wyss and Co, of Zurich. Feb. 24th, 1904.—This invention relates to guide apparatus for steam and gas turbines, in which the blades are held in place by means of grooves and locking rings, In guide apparatus constructed in accordance with this invention the blades are formed with extensions which are inserted into grooves in the part carrying the blade wherein they are held by means of a locking ring that is let into the said part and engages in recesses formed in the extensions of the blades. The guide blades are formed with radially arranged extensions which are adapted to be inserted into grooves in a disc. The extensions are formed with recesses into which there engages a locking ring which is let into one face of the disc and is composed of a number of arc segments attached by means of screws to the wheel centre. This ring serves to keep the blade in position. In a modification the extensions may be located on the opposite side of the blade, and in this case the slots will be situated in the ring in which the locking ring will be inserted. The drawings show a front elevation of the invention, and details thereof.



BOILERS.

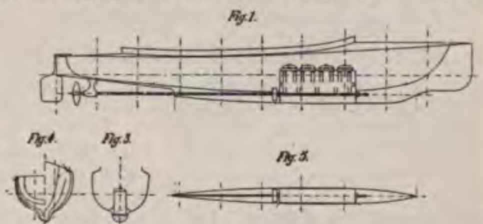
M. Deprez and J. Verney, of Paris. July 1st, 1904.—This invention, which is based on the scientific researches and experiments of Mr. Marcel Deprez, relates to an apparatus for maintaining a constant water level in boilers by the automatic control or operation of a water supply cock or of the steam supply to the pump, if a steam pump is used, said operation being effected by the rod of a piston on which the steam acts, said steam being admitted by a pin valve, operated by a float or other suitable means. The apparatus consists of a float arranged within a casing communicating with the boiler and provided with a lever oscillating on a pivot or knife-edge, mounted on a support fixed to the casing, in combination with a pin-valve resting on the lever. A spring bears at one end on a fixed part of the apparatus, and the other end on the end of the pin-valve-rod, in such a manner as to force the pin-valve to follow the movements of said lever. The pin-valve is adapted to close a channel communicating with the steam space of the boiler and a cylinder communicates with this channel, and is provided with a piston acted upon by a spring to move it to the end of the cylinder, the piston acting on the feed-water supply-cock.





SCREW-PROPELLED VESSELS.

J. A. Normand, F. E. Normand, and M. E. Normand, trading as Société Augustin Normand et Cie, of Le Havre, France. Jan. 16th, 1904. (Date claimed under the International Convention).—This invention relates to screw-propelled vessels having a screw, or screws, fixed to a single shaft, and has for its object to obtain a better utilisation of the motive power. The principal feature of this invention resides in forming a small hull under the principal hull, to which it is connected by continuous curves, the said small hull having a length and sharpness of such a form as to reduce to a minimum its resistance to propulsion. This smaller hull must be sufficiently wide and deep to allow of the rotary motion of the cranks and connecting-rod ends, and also when enclosed hydro-carbon motors are used, sufficiently wide and deep to receive the crank chamber of the motor. This arrangement differs from any of those previously tried, the small hull being made as short as compatible with the desired smallness or width or fineness of the lines of the vessel, and neither holding ballast nor containing the engines or boilers, its transverse dimensions being limited to what is necessary to permit of the propeller-shaft being in the position described, and to leave sufficient space for the rotation of the cranks and connecting-rods of a motor of the inverted cylinder type



NEW PUBLICATIONS.

"CENTRAL ELECTRICAL STATIONS:

Their Design, Organisation, and Management." By Charles Henry Wordingham, A.K.C. Second Edition. Charles Griffin and Co. Ltd. 24s. net.

Mr. Wordingham is fully cognisant with the fact that to attempt to deal exhaustively with central station work in one volume would be a task futile and impossible, for, as he remarks, no field of engineering practice involves more varied and numerous branches of science. The writer's aim in the present volume has been to give a comprehensive account of the problems which arise in the practical administration of central stations, whether of a scientific, an engineering, or a commercial nature; he discusses the general principles of design and operation, the training desirable for an engineer specialising in the branch of electrical engineering, and the field he may reasonably expect to be open to him. In the section devoted to central station work as a profession, the author gives some sound advice on the education of the young engineer; he strongly advocates theoretical training before practical, and objects to the students specialising too soon. The establishment of a central station, is amply discussed, the author then deals successively with systems of supply; the choice of a site for the generating station; architectural features of generating and transforming stations; choice of size and type of plant and general design of station; boilers, systems of draught and economy of waste heat; methods of firing boilers; coal handling, weighing and storing; the feeding of boilers; the transmission of steam; generators; condensing appliances; switching gear, instruments, and electrical connections; distributing mains—drawing-in systems, built-in systems, various dielectrics, insulation resistance and cost; distributing networks; service mains and feeders; testing of mains; recording the laying of mains; meters and appliances on consumers' premises; standardising and testing laboratory; secondary batteries; street lighting; the cost of production; methods of charging regulations of consumers' installations; general organisation of a central station; the generating station; the mains department; the installation department, the standardising department; the drawing office; the clerical department; the consumer; the routine of main laying. The work is profusely illustrated, including a number of folding ground plans and specimens of the various cards, forms and sheets designed for use in the clerical department, the organisation of which is carefully detailed.

SMITHSONIAN INSTITUTION REPORT.

Annual Report of the Board of Regents, showing the Operations, Expenditures, and Condition of the Institution for the year ending June 30th, 1903. Washington: The Government Printing Office, 1904.

The recently issued annual report of the Smithsonian Institution is a production upon which the authorities are to be heartily congratulated; the greatest care appears to have been expended upon the volume, and the illustrations and letterpress attain to a high standard of excellence. Following the secretary's collective statement of the year's transactions, among the more detailed accounts of investigations or discoveries by those who were directly responsible for the researches will be found much that is of permanent interest to the engineer, notably the articles on radium, ærial navigation, the electric furnace, high-speed electric interurban railways, and the Marienfelde Zossen high-speed electric railway trials, while Professor W. F. Durand contributes a scholarly appreciation of that eminent scientist and engineer, the late Robert Henry Thurston.

NEW CATALOGUES.

Messrs. Hartley and Sugden, Ltd., of Atlas Works, Halifax, have issued a new illustrated price list of the firm's low-pressure steam boilers; riveted high-pressure steam boilers and cylinder; steam heaters; independent hot water boilers; hot water boilers for brickwork setting; range boilers; steam jacketed pans and ovens; furnace pans and foundry ladles; hot water pipes and valves; cast-iron sectional boilers; radiators and fittings. Amongst the firm's specialities particular attention is called to the "Savile" boiler, specially designed for heating water for domestic supply in hotels, clubs and country houses; and to the cast-iron "White Rose" Sectional Boiler for low-pressure steam heating.

A neat little booklet printed in two colours on art paper, and devoted to an enumeration of the firm's specialities, has been issued by Messrs. Zeitz and Co., of 21, Lime Street, E.C., manufacturers of high-grade steel, files and tools.

Messrs. Kramos, Ltd., Bath. Price list No 3 describes and illustrates the Kramos Patent Electrical Resistance Pieces.

Messrs. Ferranti, Ltd., Hollinwood, Lancs. Catalogue No. 7 is devoted to current transformers for ammeters, power factor indicators, relays, and indicating wattmeters. Catalogue No. 13 is a price list of alternating current ammeters. Our attention is particularly drawn to the fact that the ammeter is of the induction pattern, the only moving part being a small aluminium disc. A special feature is its long open scale.

Messrs. Herbert Morris and Bastert, Ltd., Empress Works, Loughborough. Book 43 describes and illustrates h.m.b. spur gear pulley blocks, travelling pulley blocks, overhead runaways, hand overhead cranes, and electric overhead cranes. Attention is specially directed to the 1904 pattern of Class 44 electric crane, of which we note fuller particulars are given in book 47.

MEETINGS FOR THE ENSUING WEEK.

FRIDAY, FEB. 17.—Geological Society: Anniversary Meeting, 8 p.m.—Chamber of Shipping: Meeting, Cannon Street Hotel, 11; Dinner, Hotel Metropole, 7 p.m.—Royal Institution, 9 p.m.: Paper, "High-Power Microscopy," Mr. J. W. Gordon.—North-East Coast Institution of Engineers and shipbuilders, Newcastle.—Institution of Mechanical Engineers, Storey's Gate, S.W. 8 p.m.: Annual General Meeting, Adjourned discussion on American Visit: Paper, "The Strength of Columns," Professor W. E. Lilley.

SATURDAY, FEB. 18.—Glasgow Technical Society, 7.30: "High Speed Tool Steels from the Users' Point of View," Mr. E. H. Robertson.—Staffordshire Iron and Steel Institute: "The Microstructure of Cast Iron," Mr. D. F. Hudson.—Institution of Electrical Engineers: Students Meeting, Paper, "Notes on the Construction of Large Telephone Equipments," by Mr. A. L. Stanton.

MONDAY, FEB. 20.—Society of Arts, 8 p.m.: "Internal Combustion Engines," Mr. Dugald Clerk.—Institute of Marine Engineers, Stratford, 8 p.m.

TUESDAY, FEB. 21.—Thomas Binney Institute, 8.30: Paper, "Modern Business: its Methods and Mistakes," Mr. G. C. Rickett, M.P.

WEDNESDAY, FEB. 22.—Society of Arts, 8 p.m.: Liverpool Engineering Society, Paper, "Sundry Practical Notes on Dock Construction," Mr. Fielden Sutcliffe.—Geological Society of London, 8 p.m.

THURSDAY, FEB. 23.—Institution of Electrical Engineers, Great George Street, S.W., 8 p.m.—Royal Institution, 5 p.m.: Paper, "Recent Work of the Geological Society," Mr. J. H. Teall.—Royal Society, 4.30 p.m.—Dundee Institute of Engineers: Paper, "Internally Fired Boilers," Mr. R. F. Sturrock.

FRIDAY, FEB. 24.—Manchester Motor Show Opens.—Edinburgh Motor Show Opens.—Royal Society, 9 p.m.: Paper, "Fungi," Professor H. Marshall Ward.—Physical Society.—Electro-Harmonic Smoker, Holborn Restaurant, Ladies' Night.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

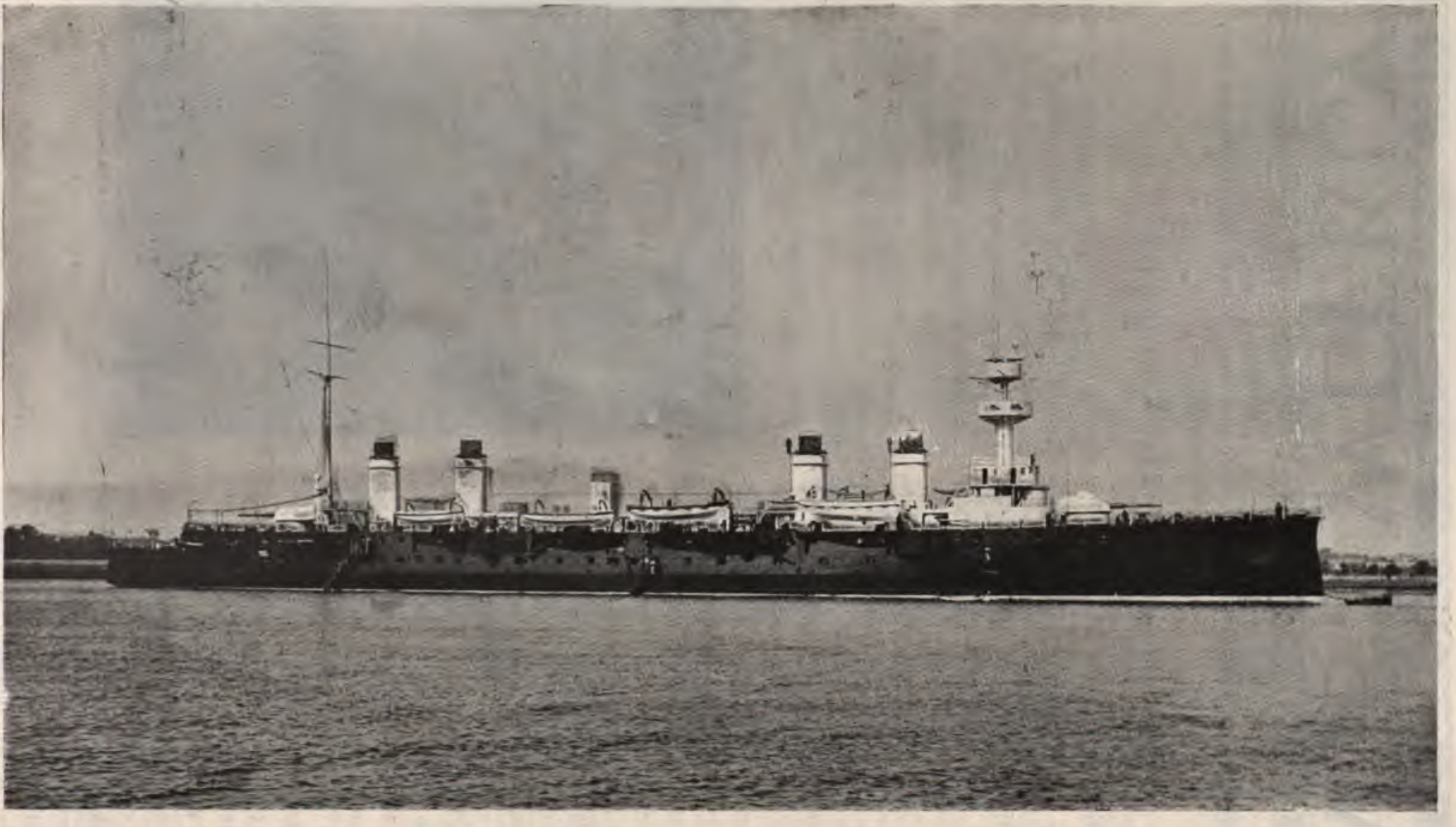
VOL. VI. LONDON, FRIDAY, FEBRUARY 24, 1905. No 24.

The Offices of "Page's Weekly," Wednesday, Midnight.

THE question of under-ground hoisting in deep-level mines is one which is being freely discussed just now by the mining engineers of the Rand, and there appears to be not a little difference of opinion as to the best method of setting about it. The economical handling of ore in inclines sunk from an underground horizon and performing functions complementary to main vertical shafts has exercised the mind of Mr. G. A. Denny, to a considerable extent, and his conclusions recently given at a meeting of the South African Association of Engineers were entirely in favour of conveyor belts. In the majority of mines with banket reefs lying at a depth of 3,500 ft. it seems unlikely that inclinations of more than 20 deg. will have to be dealt with, while, according to Mr. Denny, the practical angle to which a conveyor belt can be run on the usual troughing idler scheme is little more than 20 deg., the maximum under the most favourable conditions being 23 deg. Schemes are on foot which contemplate the use of conveyor belts up to angles of 45 deg., but in this case before the inclination is reached a belt similar in all respects to the conveyor and travelling at the same speed, makes contact with it, causing the fragments of ore to be firmly held between the belts. Such an arrangement has been patented by Mr. B. H. Norton. Mr. Denny, however, has apparently confined his attention to belts intended for the less severe gradients, and in the paper alluded to, he described a plant with three belts figured on the requirements of a 200 stamp mill, which it is assumed would require 1,600 tons of ore to be delivered at surface per day to feed it with 1,200 tons of sorted rock; plus the tonnage of waste rock, which is kept separate from the mill rock, and is separately disposed of at the surface.

MR. EDWARD PRITCHARD MARTIN.

Who has just been elected President of the Institution of Mechanical Engineers (see page 427).



By courtesy of the Royal United Service Institution.]

THE NEW FRENCH FIRST-CLASS ARMOURED CRUISER "AMIRAL-GUEYDON," 9,517 TONS; 19,600 I.H.P.; SPEED, 21 KNOTS.

ARMOUR PROTECTION: Water-line belt of 6-in, H.N.S., ending short way from stern in a 3·4-in. transverse bulkhead; an upper belt 3·7 in. to 2·4 in. thick, reaching just up to main deck Turrets, 6-in. with 4-in. ammunition hoists; main deck casemates and turrets for 6·4-in. guns, 4 in.; fore conning tower, 8 in.

ARMAMENT: Two 7 6-in. quick-firing in two turrets, one forward and one aft; four 6·4-in. quick-firing in casemates and four in turrets on upper deck; four 3·9-in. in shields; sixteen 3 pounder and six 1-pounder quick-firing guns, with two submerged torpedo-tubes.

The daily total to be dealt with by the three belts was estimated at 1,750 tons, and for this a belt 26 in. in width was proposed, capable of easily handling 70 to 80 tons per hour, at a belt speed of 250 feet per minute. Calculating the problem out on a basis of 35 tons per hour as being nearer the actual conditions, the power required was estimated at 12·5 h.p., on the maker's formulæ, and 14·5 h.p. on the general formulæ applicable to this class of problem.

There is not, according to Mr. J. A. Vaughan, a great deal of published information regarding the work performed by conveyor belts. To the Mechanical Engineers' Association of the Witwatersrand a few months ago, Mr. E. Farrar gave some interesting and instructive notes on an installation of Belt Conveyors at the Van Ryn G. M. Estate. One belt carried 142,800 lb. of rock per hour 199 ft. horizontally and raised it 48·5 ft. Power, including motor losses, = 8·11 h.p. Efficiency estimated on the vertical lift=43·12 per cent. Empty belt took 3·69 h.p. The other belt carried 177,856 lb. of rock per hour 497·5 ft. horizontally and raised it 25·5 ft. Power, including motor losses,= 8·47 h.p. Efficiency estimated on the vertical 2 lift=7·04 per cent. The empty belt took 2·94 h.p. or perhaps 40 per cent. efficiency allowing for the driving of the travelling "tipper." Naturally there has been a good deal of discussion as to the relative strength of conveyor belts. Mr. Vaughan calculated that the belt per 1 lb. a foot has a breaking load of about 7,200 lb. Chain has a breaking load of about 6,600 lb., hemp rope, 22,000 lb., and best plough steel wire rope, say, 65,000 lb. Whereas ropes and chains need a skip or bucket to carry the load, constituting extra weight to be carried, the belt is, of course, its own bucket.

As illustrating the difficulties encountered in the use of this form of conveyor, one speaker at this meeting (Mr. A. W. K. Peirce) mentioned that at the Knight's Deep, they installed a conveyor belt for handling sands, tailings and waste rock from the sorting house, and found, operating on rock alone, the inclination of 20 degrees was a little bit steep. There was trouble when a piece of rock of a more or less symmetrical formation got on to the belt, as it was apt to roll, and it was "exciting at times." The rocks would get half way up the belt and would then start rolling down and fly off, and it was found necessary to lower the inclination a little. Other criticisms were raised by Mr. J. G. Lawn, who considered that the problem was largely a matter of angle. If the latter was fairly considerable say 20 deg., or anything above that, he thought a good many mining engineers would be satisfied with the skip as being the best appliance to use, especially as they could choose from an almost endless variety of modifications, of either continuous haulage, an endless rope, an aerial haulage. If the angle of the shaft exceeded 20 deg., he would be inclined to put in skips. At the lower angles mentioned as obtaining in some of the deep level properties of the Rand, such as 6 or 7 deg., he would be inclined to one of the endless rope systems which have been brought to such perfection in the North of England and on the Continent of Europe. For intermediate angles, a system of aerial haulage would be worth considering. Electric traction might also render useful service in this connection.

All this, however, did not convince Mr. Denny, who claimed that during the last three years mining engineers on the Rand have had a good opportunity of ascertaining the cost of maintenance and labour in connection with belt systems, and of satisfying themselves that the costs are low.

Mr. Axel Orling, whose inventions in connection with the Armstrong-Orling system of wireless telegraphy were dealt with in our issue of November 1st, 1902, is a Swede, having been born at Stockholm in 1870. This fact, as well as the part played by the young inventor in the development of wireless telegraphy, has induced our enterprising Swedish contemporary Affarsvarlden to devote considerable attention to Mr. Orling's work, and we are indebted to the editor of that journal for the accompanying photo. Mr. Orling studied in the United States under Cabot, and there constructed his electrical gas lighter. In 1890 he came over to England, and since 1895 has been associated with Mr. Armstrong, with the exception of the year 1897, when he went over to Stockholm to demonstrate an invention connected with the guiding of torpedoes. Mr. Orling has devoted a great deal of attention to the study of mechanics. His patents number not less than 150, most of them, however, being for electrical contrivances.

A NEW PORTRAIT OF THE SWEDISH INVENTOR, MR. AXEL ORLING.

Mr. Alexander E. Outerbridge, Jun., of Messrs. William Sellers and Co., Philadelphia, has been telling the American Academy of Political and Social Science what he knows about specialisation in manufacture, and his paper, which lies before us, summarises very well the benefits of a system which has been widely adopted in America and is generally extolled. We find the manufacturer prone to select some article or product for which there is a heavy or a constant demand. He will then, by devoting himself and his capital to its development, so reduce the cost of production as to secure at least partial control of the trade. This implies a complete equipment of the most modern machinery—hence the scrap-heap which looms so largely in American industrial affairs. Mr. Outerbridge remarks that the secret of success in manufacturing lies largely in concentration of effort and the development of plant to the highest degree, so that a superior product may be turned out at a minimum cost. This will be readily conceded, but it would appear that at times even our American friends discover sundry inherent drawbacks in the plan of carrying all one's eggs in a single basket. The danger of over-production in this modern system of specialisation is one of which there have been many evidences of late. Again, to quote Mr. Outerbridge : "An establishment may have its capital tied up in a complete outfit of machinery, designed to produce one article at the lowest cost, for which there may be a constant demand at a remunerative price. Then an ingenious inventor may design a new machine, or devise a new method of manufacture, which will, perhaps, produce better goods at far lower cost, and the utility of the old plant is at once destroyed. Its costly machinery may be of little or no value for any other purpose, and so a hitherto profitable industry may be wiped out of existence at one fell swoop. This is not an imaginary statement; the author supports it by numerous facts.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

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Alterations, &c., intended for insertion in the current week's issue must be delivered **not later than 4 p.m. on Monday.** If proofs are required the copy and blocks should reach us several days earlier.

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NEWS ITEMS.

At a meeting held at the Hotel Cecil under the auspices of the National Electrical Manufacturers' Association, it was decided to hold a general electrical exhibition; this will probably be held at Olympia or the Crystal Palace in October.

Mr. G. H. Stanley, A.R.S.M., the Demonstrator in Metallurgy and Surveying of Armstrong College, Newcastle-upon-Tyne, has been elected to the Professorship of Metallurgy in the Technical Institute, Johannesburg.

Mr. T. W. Sheffield, A.M.I.E.E., A.M.I.Mech.E., has favoured us with a copy of his useful and valuable paper on "Safety Devices for Electric Tramways." It is a suggestive survey, which should be in the hands of all tramway managers.

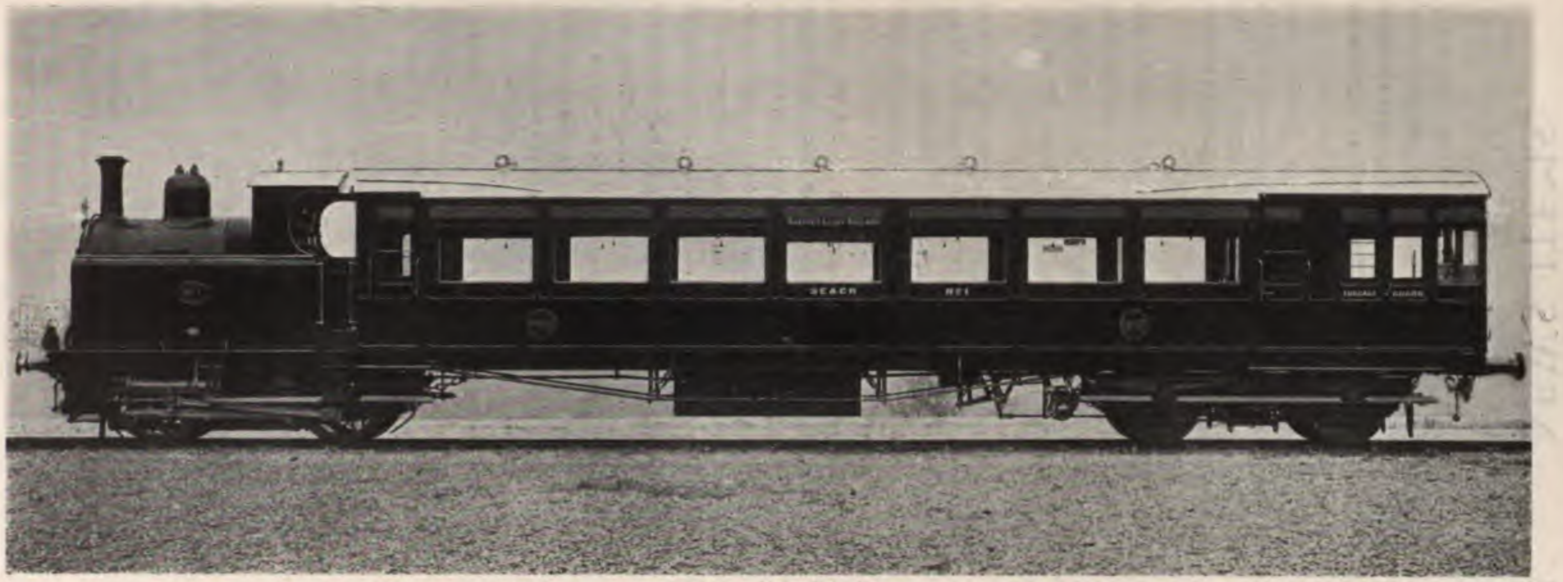
The centenary of the establishment of the works of Rylands Brothers, Ltd., wire manufacturers, of Warrington, was recently celebrated by a dinner to the employees. The business, which was founded by John and William Rylands in 1619.

We are desired to call attention to the fact that, as the new locomotive works of the Avonside Engine Company, Bristol, are practically completed, the whole of the business will be conducted from the new works, and that their address on and after February 27th, will be Avonside Engine Works, Fishponds, Bristol.

Towards a sum of £170,000, required as an establishment fund, for the new University of Sheffield, Mr. Edgar Allen has offered £10,000, if four others will subscribe £10,000 each towards the £57,000 required to complete this sum. As an alternative, he offers £5,000, if nine others will contribute a similar sum.

The Council of University College, London, in accepting with much regret the resignation of Professor L. F. Vernon-Harcourt of his office of Professor of Civil Engineering and Surveying, referred to their high appreciation of the services he has rendered to the college during his long connection with it, and to the distinction he has conferred upon the chair.

Mr. Frank McClean, the well-known engineer, made large bequests to educational bodies. To the University of Birmingham he left £5,000 to be applied in the department of physical science, and to Cambridge £5,000 to be expended in improving the instrumental equipment of the Newall Observatory. His other bequests to scientific bodies included the Royal Society, £2,000; Royal Institution, £2,000; and Royal Astronomical Society, £2,000.



NEW STEAM MOTOR CARRIAGES FOR THE SOUTH-EASTERN AND CHATHAM RAILWAY.

Built to the designs of Mr. Harry S. Wainwright, M.Inst.C.E., Chief Mechanical Engineer S.E. and C. Railway, by Messrs. Kitson and Co., of Leeds, and the Metropolitan Amalgamated Railway Carriage and Wagon Company, Ltd., Oldbury, Birmingham.

IN this type the engine is carried on a four-wheel bogie, the bogie centre pivot being fixed to a cross beam at the end of the carriage underframe; the wheel base of engine bogie measures 8 ft., and the wheels 3 ft. 7 in. diameter. The cylinders are placed outside the frames, being of 10 in. diameter by 15 in. stroke.

The boiler is of the loco-type, and is fitted with a Belpaire firebox. Heating surface: Firebox, 44·5 square feet; tubes, 337 square feet; total, 381 square feet. Grate, 8·8. square feet. Working pressure, 160 lb. per square inch. Water tanks are placed at the sides and between the bogie frames. Total capacity, 400 gallons.

The coal bunkers are at the ends of side tanks, and carry about 15 cwt. The engine can be readily detached from the carriage, and can be run separately when in steam. Further details are as follows: total length over buffers is 64 ft. 11¼ in. Total weight of steam motor carriage, when unloaded, about 38 tons, distributed as follows: 24½ tons on engine bogie, and 13½ tons on carriage bogie.

The steam motor carriage is capable of taking an additional trailer carriage, weighing 16 tons, at a speed of over 35 miles per hour on a level, and an average speed, including gradients of 30 miles per hour. The car runs very smoothly, rubber being largely employed to prevent vibration. The engine coal consumption is extremely small, and economy in maintenance in several directions will, no doubt, result.

The carriage body is 48 ft. 4 in. long outside, and is divided into three compartments: Third-class non-smoking, next to engine, 19 ft. $10\frac{3}{8}$ in. long; a third-class smoking compartment, 14 ft. $10\frac{7}{8}$ in. long; and a lugage and guard's compartment at the end 6 ft. 8 in. long.

A vestibule is placed at the end, next to the engine, also at the luggage compartment. Ordinary hinged doors, opening inwards, are placed on the side of the body, and sliding doors are arranged in the passenger and guard's compartments. The passenger compartments are finished in teak, the seats being arranged back to back, with a gangway down the centre. Seating accommodation, thirty-two non-smoking and twenty-four smoking; ventilation is provided over each window and in the roof; entrance to the car is effected by the end vestibule, leading to the non-smoking and the smoking compartments, respectively.

The car underframe is constructed of steel, and is carried at one end by a four-wheel carriage bogie, with 8-ft. wheel base, and 3-ft. 6 in. wheels; the other end of the car, which is supported on the engine bogie, is cushioned with india rubber pads. The vacuum automatic brake is provided with a hand-brake on the carriage and engine in addition. The cars are fitted with Stone's system of electric lighting. The steam regulator, reversing gear, whistle, vacuum, and hand-brakes are worked by the driver from either end, and the guard can communicate with the driver by means of electric bells.

The Coal Tax.

Since Bndget proposals cannot be anticipated, the Chancellor of the Exchequer was able to afford little satisfaction to the influential deputation of coal miners who waited upon him at the Treasury last week to urge the removal of the Coal tax. The members were assured that their representations would receive "proper consideration," which one might presume was a foregone conclusion, but no inference was to be drawn as to the decision of the Chancellor of the Exchequer in the matter or that of the Government. The objections raised by the deputation were certainly formidable. Mr. Watts Morgan (South Wales) called attention to the large amount of distress which had existed in Glamorgan owing to colliers being out of work. He urged that the mining industry of this country might be untrammelled, since those who were engaged in it had already enough to do to meet foreign competition. One of the other speakers—Mr. J. W. Taylor, of Durham—said that in Durham and Northumberland, and particularly in the latter county, the prices of coal had fallen with the imposition of the tax, so as to make a difference of 6s. 3d. in every sovereign earned by the worker. Keen competition in the sale of coal between different countries, if not affecting the volume of trade, had a very injurious effect upon the prices realised; and as the average selling price regulated wages the worker suffered from any decrease in price. Consular reports and the Royal Commission report furnished additional arguments against the tax. The deputation hoped that Mr. Chamberlain's open mind would lead him to give the relief asked. Mr. Austen Chamberlain made it quite clear however that nothing can be stated as to the Government's propositions for the next financial year until his Budget statement is forthcoming in the House of Commons.

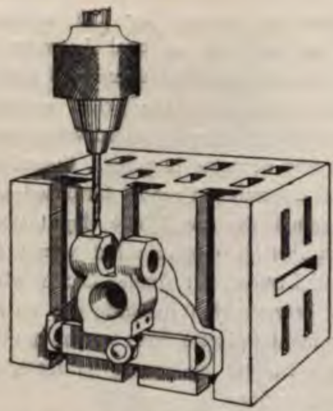
The Telephone Question.

Considerable interest has been manifested in the statement that an agreement has been made between the Postmaster-General and the National Telephone Company, Limited, for the acquisition of the business of the company by the State. It will thus be seen that another phase of what is known as the telephone question—which has already been dealt with very extensively in PAGE'S WEEKLY, under the heading of Questions of the Day, has presented itself, and that an important step has been taken in the evolution of the telephone business in this country.

A Heavier Standard Rail on the North Western Railway.

Lord Stalbridge, in the course of his remarks as chairman at the half-yearly meeting of shareholders of the London and North-Western Railway Company, said he had every reason to believe that the expenses of relaying had reached the highest point and that for the future there would not be an increase. They proposed to relay with a heavier standard rail; the weight of the new rail would be 95 lb. per yard. In locomotive power considerable saving was exhibited, greatly owing to the more powerful engines which had been built, as well as, of course, to the reduced mileage of the goods trains. A large diminution was also shown in engine mileage, owing, among other causes, to the additional power of the engines, so that one engine only was required where two were needed before.

The late Mr. John Henry Austin, of the firm of John H. Austin and Co., iron and steel merchants, 61 and 62, Gracechurch Street, London, E.C., left property valued at £80,734 gross.



NEW BOX JIG BY EDWARD G. HERBERT, LTD.

Spherical Metalic Packing.

Redford's patent metallic packing, of which a section is shown herewith, is entirely self-adjusting. It does not require a stuffing box, but can with equal facility be fixed in existing boxes. If the rod is out of alignment, the spheres move freely one within the other, in the form of a ball and socket joint, so that the special bronze anti-friction metal packing pieces endure no stresses from this cause. The illustration shows the packing fixed inside an existing stuffing box. When fixed it is fully open to view, and can be seen yielding gently to every motion of the rod, and at the same time rotating under all conditions of pressures. The only pressure on the rod is that exerted by the light springs round the bronze anti-friction metal pieces. This, the makers inform us, is only about ·5 to 1 lb. per square inch surface contact. It therefore reduces the friction to a minimum, the pressure being the same under all loads and steam pressures.

The lubrication employed keeps the rod surrounded with oil in the space left in the cover for the vibration of the rod. This oil, being away from the heat of the cylinders and steam prevents carbonisation through high temperatures and super-heated steam.

Among other advantages claimed for this arrangement are saving of oil, constant automatic lubrication of the rod, cleanly appearance, and a minimum of attention required.

The packing is manufactured by the Spherical Metallic Packing and Engineering Company, of Manchester.

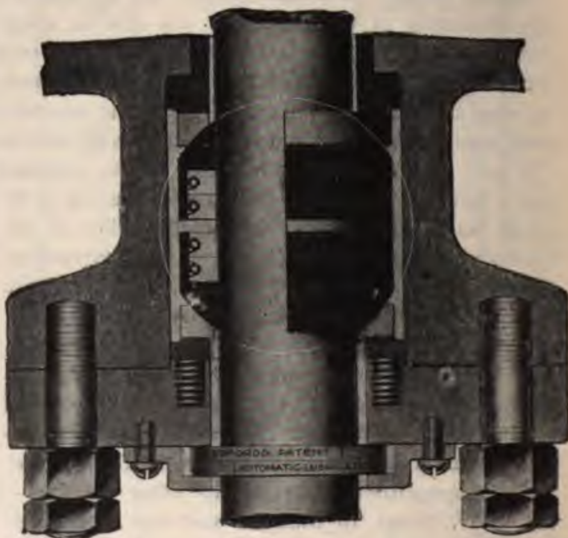
A Machine Tool Accessory.

Messrs. Edward G. Herbert, Ltd., of Manchester, have just added to their machine tool accessories a new series of Tee blocks and box jigs. One of the latter useful adjuncts to drilling and planing machines, etc., is illustrated herewith. By the use of these jigs holes can be drilled or surfaces machined on five different sides of an object at one setting. Besides saving a number of settings, this ensures that all the holes and surfaces are square or parallel to each other.

New Cables.

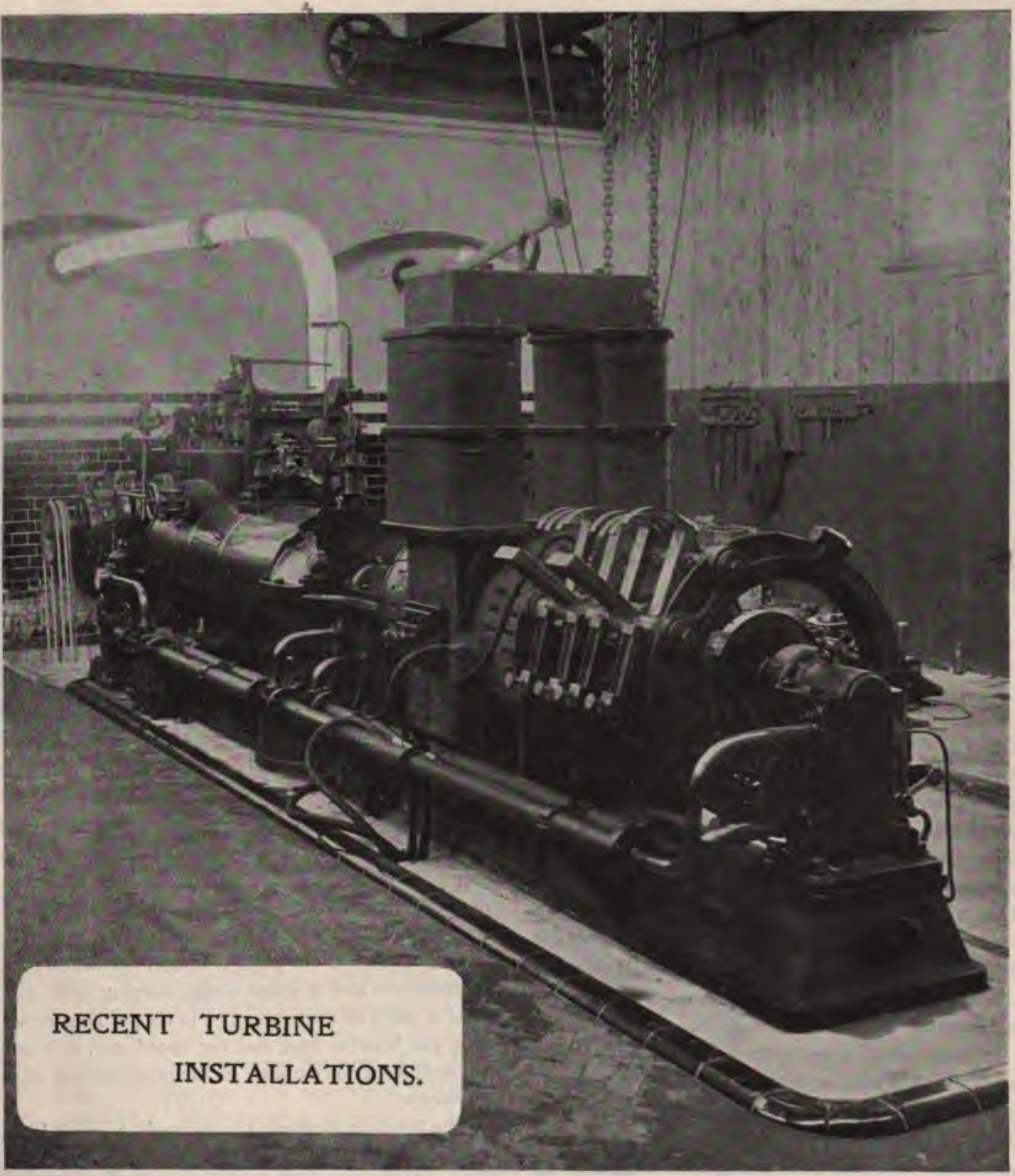
Scarcity of rubber, and the consequent high price of rubber cables, has tended to the purchase of inferior and foreign rubber cables, which, although at low cost in the first case, have frequently proved eventually to be the most expensive. Those who have in the past been compelled by competition and other circumstances to purchase such cables, will be interested to hear that Messrs. W. T. Glover and Co., Ltd., of Manchester, have now placed upon the market a second quality of low price rubber cables, which they recommend in cases where moderate insulation combined with good mechanical properties suffice, and where the conditions do not require a permanent maintenance of high elasticity of the dielectric. This second quality of cables in entitled "Non-Association." The first quality bear the familiar title "Association" cables, and are made as hitherto to the standard agreed upon by the Cable Makers' Association.

An office has been opened at 26, Victoria-street S.W., by Messrs. John M. Henderson and Co., engineers, boiler makers, and ironfounders, of Aberdeen.



REDFORD'S PATENT METALLIC PACKING

RECENT TURBINE INSTALLATIONS.



(II.) BRUSH PARSONS SET AT LOUGHBOROUGH ELECTRICITY WORKS.

The turbine sets are designed for an output of 250 kw. at 460 volts, the speed being 3,000 r.p.m. Both turbines exhaust into one condenser, and arrangements are also made so that if necessary the turbines can exhaust to atmosphere.

The air pump is of the "Edwards" type of the Brush Electrical Engineering Company's manufacture, and both it and the circulating pump are rope driven by motors bracketed to the wall on the engine room floor level. This is to obviate any possibility of the motors being damaged if the condenser pit were flooded. At the recent official trials the following steam consumptions at full load were obtained: the turbine at the time the test was taken was doing 252 kw.; speed being 3,000 kw.; steam pressure 150 lb.; superheat 181 deg. F.; vacuum obtained 28·5 in., and barometer 30·25 in. Under these conditions the water consumption per kw. hour was 19·9 lb.

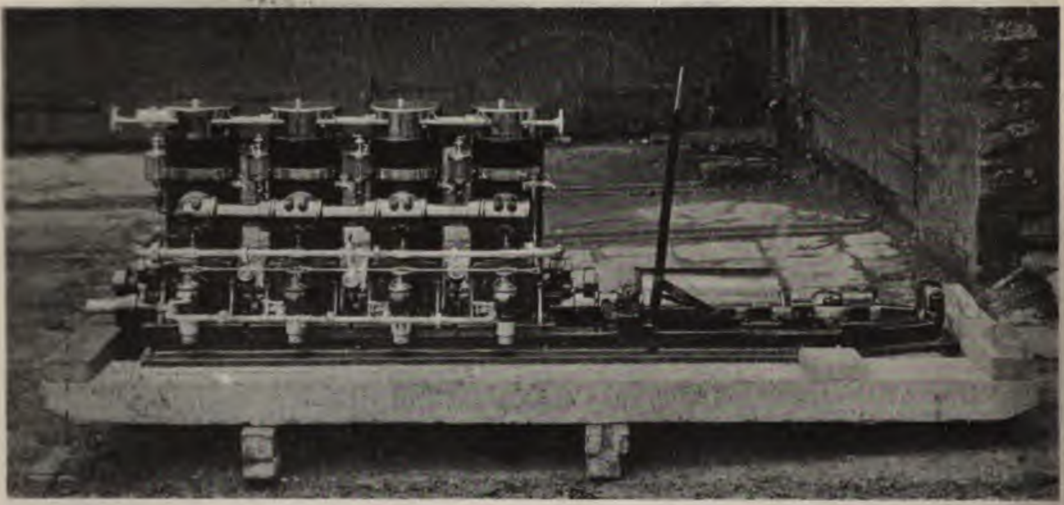


FIG. 1. FOUR-CYLINDER 14-H.P. F. AND B. MARINE MOTOR WITH REVERSING GEAR.

OLYMPIA MOTOR SHOW.

(*Continued from page* 346.)

MITCHAM MOTOR COMPANY.

The "F and B" marine motor is the speciality of this company. It is of the two-cycle type, and fig. 1 shows a four-cylinder 14 h.p. motor, fitted with reversing gear. A feature of the frame is that all the openings are large, making the whole of the parts accessible, while the cylinder head is water-jacketed, and is a perfect continuation of the cylinder itself, so that when it is removed the piston can be immediately withdrawn from the cylinder. The peculiar form of the inner surface of the cylinder head gives a superior firing chamber, and the cylinder is so constructed that the exhaust ports open appreciably earlier than the intake ports. A special feature is the ignitor, driven by a shaft passing through the motor shell and operated by gears. It is claimed that it gives perfect and instantaneous ignition, and that no "cranking up" is required. A speed lever has been designed to produce the spark with the piston at the top of the stroke, and facilitate advance sparking.

The ignitor plug contains the entire ignitor mechanism except the driving parts. This plug is ground into the cylinder head held in place by four nuts on four studs. If at any time it is desirable to examine the electrodes, the removal of the four nuts enables the plug to be taken out, and the spark tested, without in any way disturbing the adjustment of any of the parts. The Mitcham Company use a vaporiser of special design which operates only as the motor runs, feeding a charge with every upward stroke of the piston, and closing with every downward stroke shutting off the fuel entirely during explosion.

In the larger multi-cylinder motors a throttle is provided whereby all the vaporisers can be regulated simultaneously. In combination with the ignitor, this throttle gives the machine a speed range which is said to render it perfectly controllable, thus overcoming one of the most serious objections to the old pattern motor. The 2-h. p. motor is claimed to have a speed range (varying with size and style of hull) of from about 9½ miles per hour down to 1 mile per hour or less, and the speed can, it is said, be adjusted from one extreme to the other without stopping the motor.

The Mitcham Company have made a special feature of standardising all parts, in order to make them interchangeable.

HOZIER ENGINEERING COMPANY.

The "Argylls" cars attracted a good deal of attention at Olympia. The exhibit consisted of five cars, a chassis, a delivery van, and several examples of detail parts showing the improvements introduced by this firm for this year.

Fig. 5 shows a 24-h.p. four-cylinder Argyll chassis. It is fitted with a new patent automatic combined carburetter and governor. This carburretter depends for its action on a supply of petrol being provided to each cylinder by a small pump operated by means of the suction of the engine itself.

The frame of the chassis is especially heavy and is made from pressed steel. The engine is hung direct from the main frame. The cylinders are cast separately. Two ignitions are provided, high tension by batteries and high tension magneto, being fitted. Both the pump and magneto are gear-driven. The commutator is placed just under the bonnet. A novel form of joint is fitted. Fig. 3 shows the knuckle joint. It is exceedingly compact and is encased from dirt. The live axle is of ample proportions and is so arranged that the gear can be readily examined without removing the axle from the car. The brakes and the driving wheels are of a new type, being internally expanding. The clutch is a metal to metal one running in oil, consisting of an alternate series of steel discs in frictional contact with each other. The whole thing is very compact, being arranged in the flywheel.

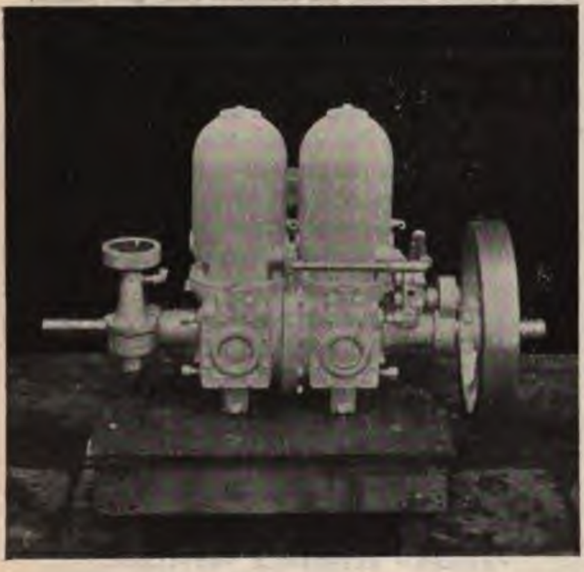


FIG. 2. 15-H.P. SPECIAL LIGHT F. AND B. MOTOR BY MITCHAM MOTOR COMPANY.

DAIMLER MOTORS.

The features which the Daimler Motor Company have had in view in designing their new models, are simplicity of design, efficiency of transmission and accessibility of parts. Points which tend to bring about this condition of affairs are the engine-starting mechanism, the speed change control and the engine single level control upon the steering wheel. The efficiency of transmission has been further improved by the introduction of the latest type D. W. M. ball bearings and the accessibility of parts may be illustrated by the design of the engine base chamber, the gear and cross shaft cases, the commutator box, the hinged body and other features.

Other points to which attention may be directed are the suspension of the engine and gear upon the main frame in a manner which ensures perfect alignment; the inclined and mechanically-operated induction and exhaust valves actuated by a single cam-shaft. The single trembler coil system of ignition with one low-tension timing brush, and distribution on the high-tension circuit, and the system of carburation,

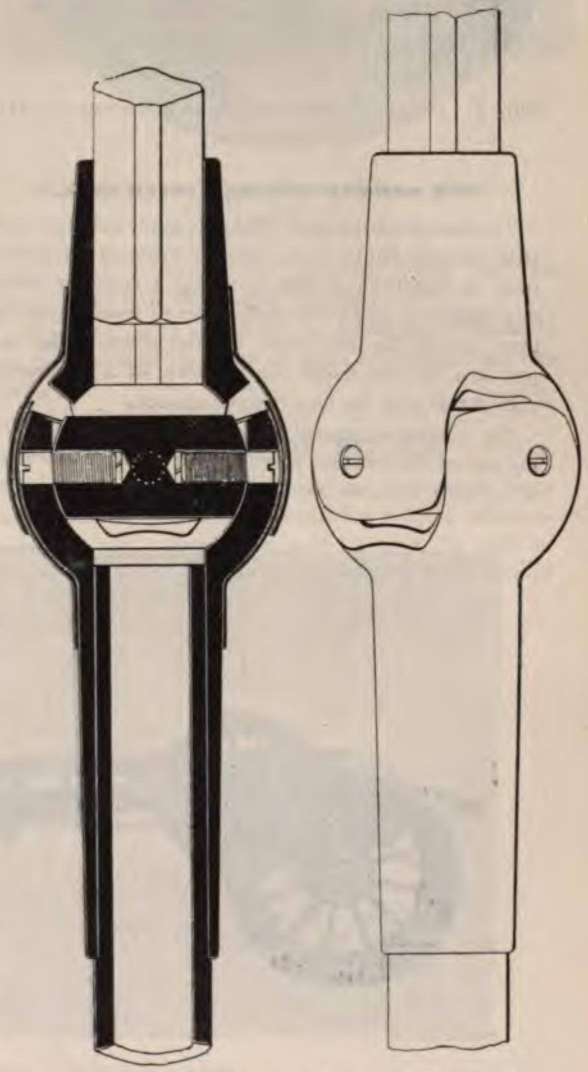


FIG. 3. ARGYLL PATENT KNUCKLE JOINT.

which is said to give constant torque at all engine speeds. Fig. 4 shows cross shaft case (Daimler type), open.

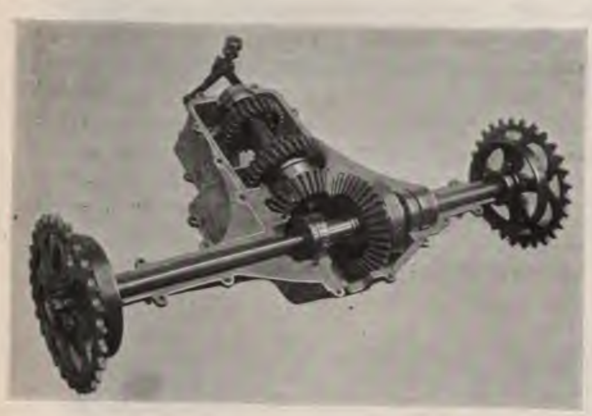


FIG. 4. DAIMLER CROSS SHAFT CASE SHOWING BALL BEARINGS.

THE NEWMAN VARIABLE SPEED GEAR.

The feature of this gear, which is applicable not only to motor-cars, but to many classes of automatic machine tools, is that from a shaft driven at a constant speed it is made to give a complete range of speeds, varying from zero to the maximum without shock. The importance to the motor-car industry of a successful gear of this type has long been recognised.

Fig. 4 gives a general view of the mechanism. On the end of the constant speed shaft a crank or eccentric of variable throw is fixed. The throw of the eccentric can be varied at will. The four gear-rings all gear with one common pinion in the centre, this pinion being fixed on the end of the variable speed shaft.

It must be understood that the eccentric is not directly connected in any way to the pinion, the constant speed shaft being supposed to stand up out of the plane of the diagram, as shown in fig. 4, and there being a space between the eccentric and the pinion. When the eccentric revolves, the clutches are moved backwards and forwards at each revolution of the eccentric through an angle depending on the throw of the eccentric. The greater the throw of the eccentric the greater will be the angle, while if the throw is reduced to zero, the clutches will be at rest. As each clutch moves backwards and forwards it drives its gear-ring through a certain distance, and then releases, but it must be observed that before it has released, the next clutch has taken up the driving, and that therefore the motion of the pinion and variable speed shaft is continuous.

Different methods are used for varying and controlling the throw of the crank or eccentric, depending on the purpose for which the gearing is intended to be used. Fig. 6 shows the Newman Variable Speed Gear arranged as countershaft. The gear can also be fitted as lathe headstock.

"GAINE'S" REVERSIBLE PROPELLER.

This stand was an interesting feature of the marine section. Fig. 9 shows the propeller outfit with section lever. Except for small powers the blades are cast in phosphor bronze, and the reversing collars are cast in gun-metal and fitted with heavy ball races, which enable

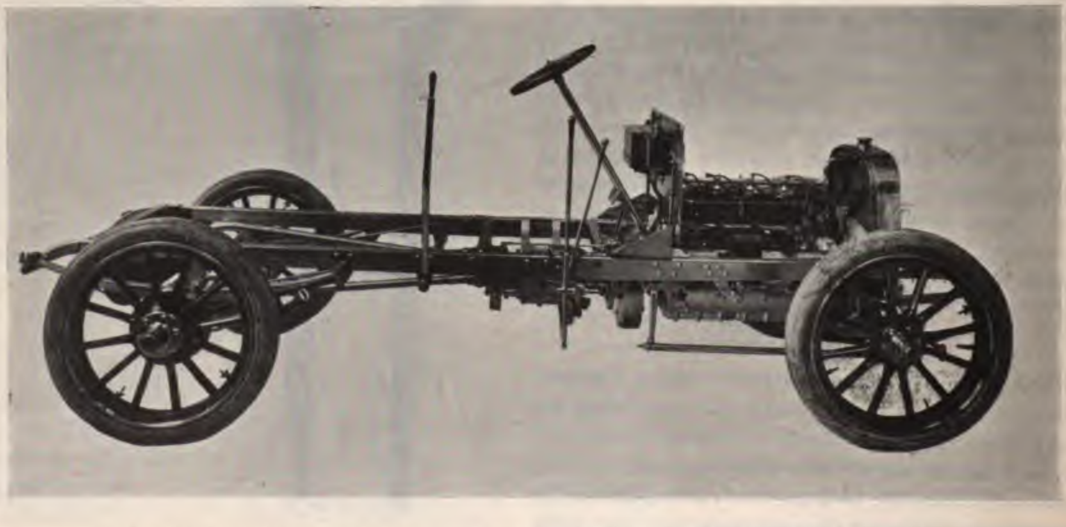


FIG. 5. ARGYLL 24-H.P. CHASSIS SHOWN BY HOZIER ENGINEERING COMPANY.

the pitch to be varied at will. The propeller boss is made in two halves transversely jointed, each half being cupped out on its interior adjacent to the joint to form a spherical bearing for the blades, the two halves of boss being kept in position by means of register ring. The locking ring boss is made with the internal mechanism identical with ordinary boss, but owing to being used for larger power the screws are secured by means of locking ring, the whole being turned down together to form solid torpedo shape.

The blades are cast in one piece of special hard gun-metal or phosphor bronze, with enlarged inner end of spherical shape on one side and a plain surface on the other. The neck of each blade rests in a bearing formed equally in the two halves of the boss. When the blades are in place a triangular space is left in the centre of the boss, which is completely filled up by the sliding block, the corners of which bear against the internal surface of the boss, the flat sides serving to support the three blades on their inner end and an efficient bearing is thus obtained for each blade.

The sliding block is made so that the blades have always full seating.

A very great feature in the propeller is that the blades can be kept at any desired pitch, and the pitch can be instantly increased or decreased without friction on the reversing collar.

A speciality is made of three-bladed reversible propellers which are specially designed and suitable for shallow-draught boats, and the use of these is recommended at all times in preference to two-bladed propellers for use with internal combustion engines, as naturally the three-bladed propeller tends greatly to steady the engines and reduces vibration. There is also a far more regular, efficient, and even drive with a three-bladed propeller than can be obtained with a two-bladed propeller.

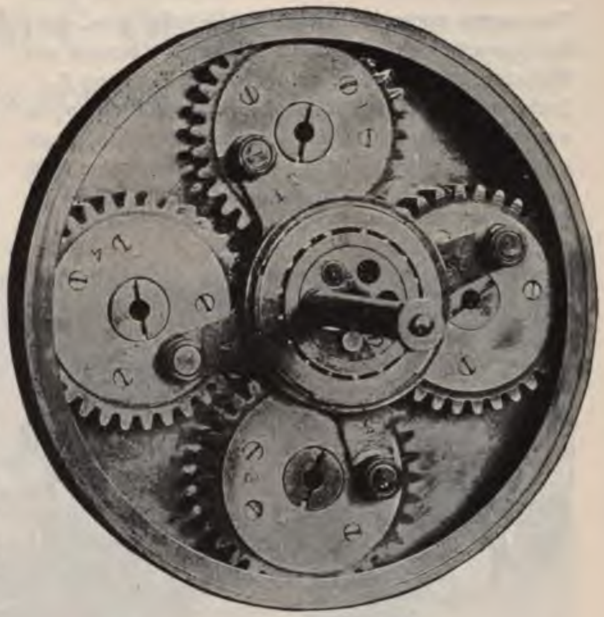


FIG. 5. NEWMAN VARIABLE GEAR. GENERAL VIEW.

A point to note is that all the mechanism is enclosed in the boss and there are no gears or levers to get out of order.

TWO MOTOR BOOKS.

The advent of the motor-car has necessarily been accompanied by a wide demand for reliable information on car construction, and it must be said in favour of the publishers that there has been no lack of

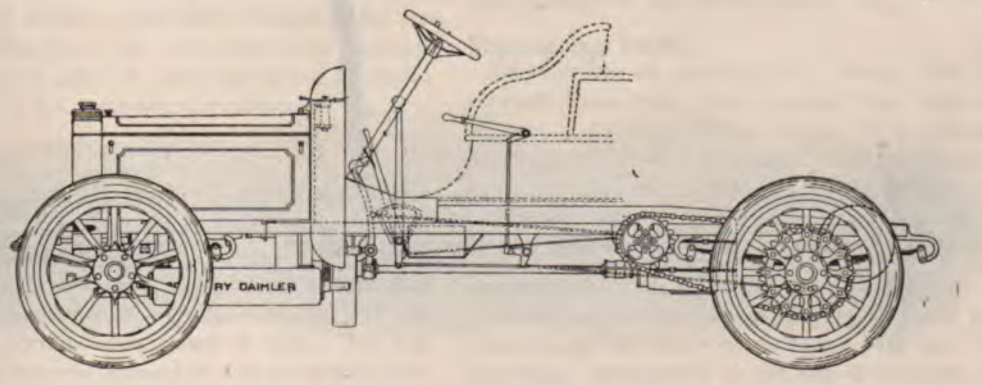


FIG. 6. DAIMLER MOTOR COMPANY'S CHASSIS.

endeavour to meet this requirement at a popular price. Two motor books, both excellent in their way, have lately reached us. Professor Spooner's "Motors and Motoring," published at 1s. by Messrs. T. C. and E. C. Jack, is much in the style of an introduction to the mechanics of motoring, and can scarcely fail to afford a good general grasp of the principles which underlie the construction and working of petrol cars. No attempt is made to describe any particular car, but a clear elucidation of principles is furnished, enabling the student to bring his knowledge to bear upon any given car.

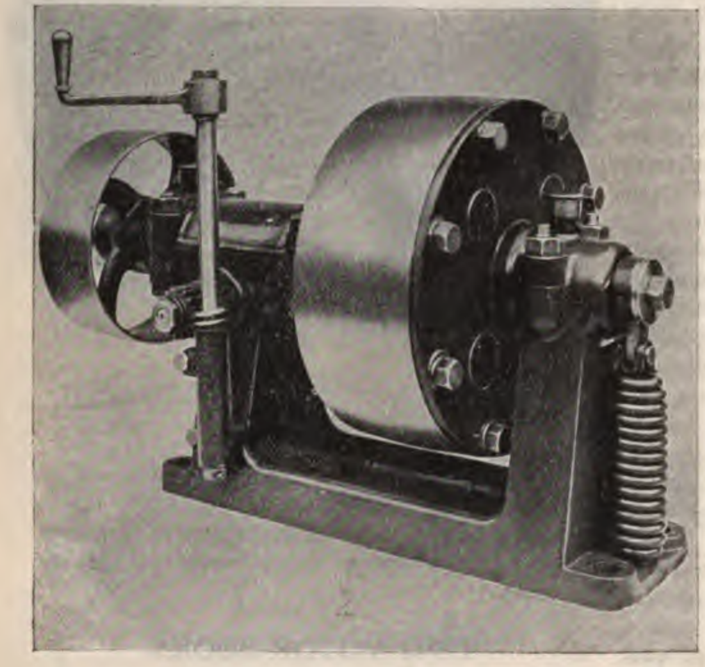


FIG. 7. NEWMAN VARIABLE GEAR, ARRANGED AS COUNTERSHAFT.

"Petrol Motors Simply Explained" is one of Messrs. Percival Marshall and Company's practical shilling manuals, the author being Mr. T. H. Hawley. The scope of the work will be fully understood from the author's object, which, by the way, has been very successfully carried out. This is to afford a simple explanation of the principles govering the action of the petrol motor, and the manner in which the power so generated is utilised to propel the vehicle, together with a few hints on control mechanism and driving ; enough, in fact, to interest the elementary reader by starting him with a clear understanding of the general subject, so that the more elaborate text books and master works will be more easily assimilated by those wishing to probe the depths of motor-car design, and also be equally useful to the embryo driver or mechanic, by enabling him to assign the proper functions of each part of the engine and the general method of construction when inspecting a cycle or car. Both the above are fully illustrated.

SOAMES CHANGE SPEED GEAR.

This gear was first exhibited at the Crystal Palace recently, but an improved form was shown at Olympia. The points claimed for the gear are that the gear wheels are always in mesh, and that it is possible to change from one gear to the other without passing through intermediate gears. There is direct drive on the top speed. The gear was fully described and illustrated in PAGE'S WEEKLY of February 3rd last.

(*To be continued.*)

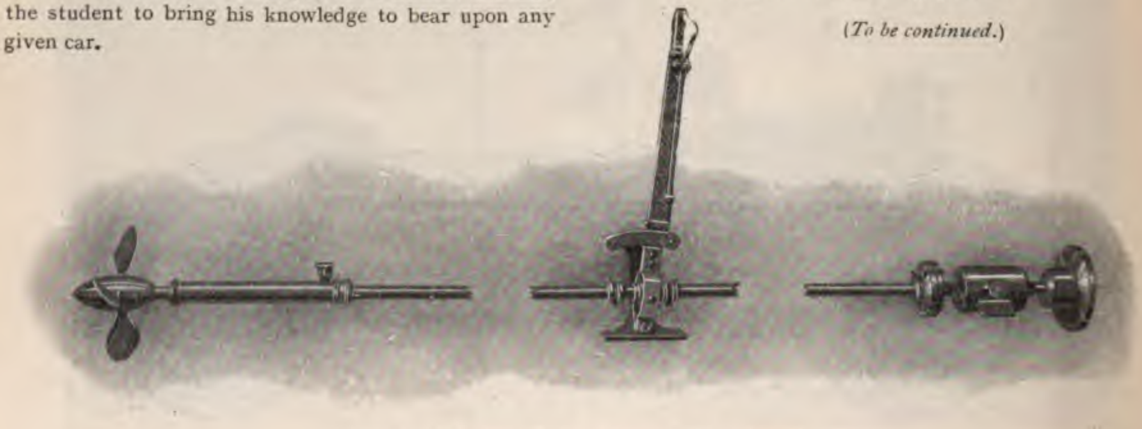


FIG. 8. "GAINES" REVERSIBLE PROPELLER.

CHEERFUL TRADE OUTLOOK.

PROSPECTS FOR 1905.

THERE is, happily, judging from the latest Board of Trade returns, some ground for the supposition that we are on the verge of a general improvement in trade. The year 1904 could not boast of anything like a satisfactory record. The downward movement in employment which commenced about the middle of 1900, continued during the year. Employment was good and better than in 1903, in tinplate manufacture; it showed little change in coal and iron mining, being moderate in the former and good in the latter; but in most other industries it was dull and showed a decline as compared with 1903.

Expectations based on Past Records.

These circumstances are set out with an official crumb of comfort. Although 1904 was much below an "average year," there have been several years in which employment was worse. Taking the previous twenty-five years, such was the case in 1879, in each of the years 1884–87, and in 1893 and 1894. Then again, it should be noted that following each of these periods of depression there has been an improvement, culminating in years of good employment (such as 1882, 1889–90, and 1899–1900 and succeeded by a decline to the next period of depresion.

Employment in January.

Are we on the rise of some such wave of prosperity? The employment statistics for the month of January would seem at any rate to offer considerable promise. Employment last month was better than in December. In the shipbuilding industry, about which we have lately heard so many pessimistic remarks, there was decided improvement, and more hands were wanted in the engineering, pig iron, and coal mining industries. The following is a summary of employment:—

Coal Mining.

Employment during January was fairly good on the whole, and slightly better than a month and a year ago. At collieries employing 544,090 workpeople, the pits worked on an average 4·95 days per week during the four weeks ended January 21st, 1905, as compared with 5·10 in the corresponding period of 1904. The time worked was, however, reduced on account of holidays to the extent of half a day per week in January, 1905, and only a quarter of a day in January, 1904.

Iron Mining.

Employment continued good, and was better than a year ago. At the 124 mines and open works covered by the returns received from employers, the average number of days worked per week during the four weeks ended January 21st was 5·50, as compared with 5·87 in December, and 5.37 a year ago. The comparison with the December period is affected by Christmas and New Year holidays to the extent of 0·45 days per week in January, 1905, and by New Year holidays to the extent of 0·25 days in January, 1904.

Pig-Iron Industry.

Employment showed some improvement as compared with a month ago, and was considerably better than a year ago. Returns relating to the works of 108 ironmasters show that 306 furnaces, employing about 22,000 workpeople, were in blast at the end of January, or four more than at the end of December, and fourteen more than at the end of January, 1904.

Iron and Steel Manufacture.

Employment was much better than a year ago. Returns relating to 224 works, employing 84,214 workpeople, showed an increase in the total volume of employment during the week ended January 28th, 1905, of 6·3 per cent. as compared with the corresponding week of January, 1904.

Tinplate Trade.

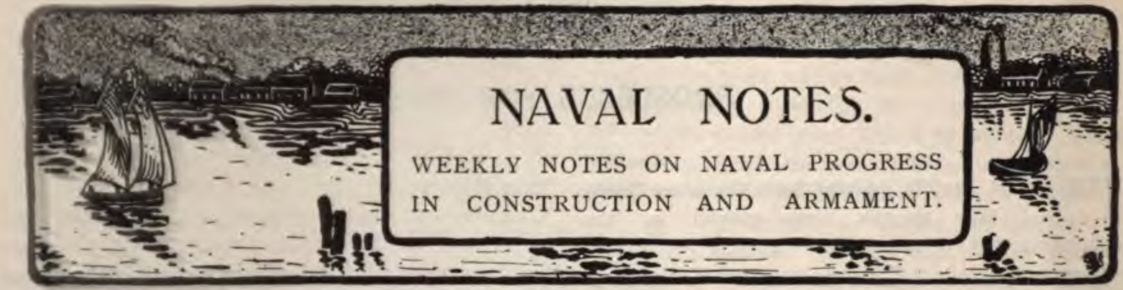
Employment in this industry was good, and was better than a month ago. It was much better than a year ago. At the end of January, 403 mills were working, as compared with 397 at the end of December, 1904, and 347 at the end of January, 1904.

Engineering Trades.

Employment in this industry, though still dull generally, was better than a month ago, especially in some of the shipbuilding centres. It is now only slightly worse than a year ago. The percentage of Trade Union members who were unemployed at the end of January, was 7·0, as compared with 8·4 at the end of December, 1904, and 6·7 at the end of January

Shipbuilding Trades.

Employment in this industry was much better than a month ago, and is now better than a year ago. The percentage unemployed at the end of January, was 12·4, as compared with 16·4 at the end of December, 1904, and 14·4 at the end of January, 1904.



NAVAL NOTES.

WEEKLY NOTES ON NAVAL PROGRESS IN CONSTRUCTION AND ARMAMENT.

(BY OUR NAVAL CORRESPONDENT.)

GREAT BRITAIN.

THE sad catastrophe at Queenstown, on board the submarine *A*5, on the 16th inst., whereby six men lost their lives, has, fortunately, been received by press and public alike without any hysterical outcry about the awful dangers of the submarine. Considering to what a degree the British seaman was ignorant of submarines only as far back as last spring, the number of serious accidents which have occurred have been very few. The explosion of gasoline at Portsmouth, when seven men were injured, the loss of *A*1 at Spithead, when the whole of the crew were drowned, and the disaster last week, are the only cases where any serious results have followed from mishaps with these craft. The report of the inquiry which has been held at Queenstown will doubtless throw some light upon the cause of the explosion, which was stated at the inquest to have been the accidental ignition of a mixture of petrol vapour and air, by an electric spark.

With any amount of rumour prevalent as to wholesale reductions in the next Navy Estimates, it becomes a problem of some importance to discover in what way economies are to be effected. That some considerable saving would be effected by the abolition of the Gunnery School at Sheerness and the transference of the classes now held there, and on board the *Cambridge* at Devonport, to the naval barracks at that port, is indisputable, and it is currently believed that some such measure has been seriously under consideration at the Admiralty. It is not proposed to interfere in any way with the work carried on at the Whale Island, where Rear-Admiral Percy Scott has just relinquished command. Admiral Scott proceeds to Whitehall to inaugurate the new Department of Target Practice, and Captain F. T. Hamilton succeeds him in the *Excellent*. If any such change in the gunnery schools, as I have outlined above, comes into force, the efficiency of gunnery training would not be in any way affected, while the economies effected would go a long way to make up the total of the reduction we are told to expect.

FRANCE.

The loss of the cruiser *Sully* in Along Bay has considerably reduced the efficient strength of the French squadron in the Far East, the fighting force being now composed only of the two armoured cruisers *Montcalm* and *Admiral Gueydon*, with the "fast" protected cruiser *Guichen*, whose speed is rather less than that of our armoured *Drake* class. There are a number of small vessels on the station, but their fighting value is nil. It is announced that in consequence of the accident to the *Sully*, which struck on an uncharted rock, the French Minister of Marine has decided to send a surveying vessel to those waters to carry out hydrographic surveys on the coast.

GERMANY.

The new Navy Bill, which Admiral von Tirpitz ha stated will be introduced next autumn, will contain provisions for the six armoured cruisers which were struck out of the Navy Bill of 1900, and seven divisions of torpedo-boats. He indicated that in the opinion of the German Admiralty, the great need of a navy was large battleships and fast cruisers. Submarines, he said, were interesting, but their value at the best was of a "local" character. From the character of the debate, which followed the announcement, it seems quite probable that the Navy Bill will be passed by the Reichstag without serious opposition.

ITALY.

The total of the Italian Navy Budget for 1905-06 is 127,246,962 francs (£5,089,878), of which 20,460,000 francs (£812,400) will be devoted to new construction. This sum does not include 600,000 francs (£24,000), which will be apportioned to the purchase and construction of submarines. The work to be carried on during the year includes the completion of the *Vittorio Emanuele* and *Regina Elena*, the advancement to the launching stage of the *Roma* and *Napoli*, the construction of one cruiser of 10,000 at *Castellamare*, and the commencement of a similar vessel at that port, the continuation of the submersibles *Glauco*, *Squalo*, *Narvalo*, *Otaria*, and *Tricheco*, and the further construction of twenty-seven torpedo-boats.

Thermometers and Pyrometers, with some of their Industrial Applications.

BY ROBERT S. WHIPPLE.

(*Continued from page* 364.)

THERMO-ELECTRIC THERMOMETERS.

I NOW come to what I may call the second group, the thermo-electric thermometers, in which is measured the electro-motive force developed by the difference in temperature of two similar thermo-electric junctions opposed to one another. Becquerel was, as far as is known, the first to use this method of measuring high temperatures (1830). He used a platinum-palladium couple. His son, Edmund Becquerel, was the first to realise the importance of using a high-resistance galvanometer with a thermo-couple. The electro-motive force is a function of the temperature, and as it is the current strength that is measured, it is important that the resistance of the whole circuit should be as nearly as possible constant; that is to say, the change in resistance of the couple itself should be small as compared with the change in the rest of the circuit. For some time the thermo-electric method was regarded with suspicion, Regnault having observed such irregularities in the couples in use that he condemned the method unreservedly.

All who are interested in high temperature thermometry owe a great debt of gratitude to M. Le Chatelier and Sir William Roberts-Austen. They taught us what metals to use for our couples, what formulæ to employ, and what apparatus to use.

Chatelier showed that very few combinations of wires make satisfactory couples. Iron, nickel, palladium, and their alloys are absolutely unsuited for the measurement of high temperatures, since, when heated, these wires give rise to parasitical currents which may be relatively intense. He found that platinum and its alloys with iridium and rhodium are, fortunately, free from these faults. Of all the couples, those consisting of platinum, and an alloy of platinum with 10 per cent, of rhodium are the most durable for use at extremely high temperatures. On the other hand, a platinum, platinum 10 per cent. iridium, couple gives a larger electro-motive force, and therefore a more open scale.

Some recent work by Holborn and others* has shown that the change (decrease) in the E.M.F. of two Pt., Pt.-Ir. (10 per cent. Ir.) thermo-couples due to glowing at 1,100 deg. C. for eight hours amounted to 6 per cent. and 14 per cent., while the change (increase) in the E.M.F. of a Pt., Pt.-Rh. (10 per cent. Rh.) couple exposed to similar conditions was only 0·5 per cent. It has also been shown that the disintegration of the metals only occurs in the presence of oxygen.

Two methods are generally employed to measure the electro-motive force of a couple; the potentiometric, or the method of compen-

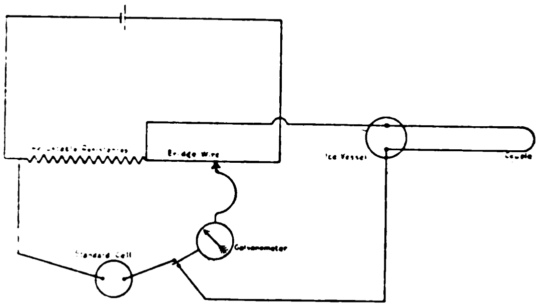


FIG. 4.

Diagram showing potentiometric method of measurement with thermo-couple.

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* Holborn and Henning, Sitzung ber. der Königl. Preuss. Akad. d. Wissensch., S. 936, 1902, and Holborn and Austin, S. 1, 1903.

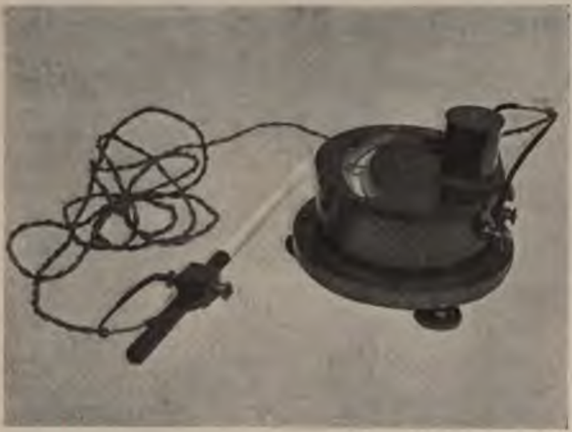

FIG. 5.
Thermo-couple with millivoltmeter reading directly in degrees Centigrade.

sation, and the galvanometric. The first method is rather cumbrous for general workshop use, but it is undoubtedly the more accurate of the two. Fig. 4 fully explains this method of measurement.

The galvanometric method is simplicity itself, the cold ends of the thermo-couple wires being connected directly to the galvanometer terminals. If the resistance of the circuit is constant, the deflections will be proportional to the electro-motive force. The majority of direct-reading instruments consist of a sensitive D'Arsonval galvanometer, the coil of which either carries a mirror reflecting a spot of light on to a scale or boom pointing to a scale. Fig. 5 illustrates the most recent form of platinum and platinum-rhodium couple made by the Cambridge Scientific Instrument Company, Ltd. The couple is connected directly to a millivoltmeter, the scale of which is divided in millivolts and degrees C.

A simple form of recorder is one in which the pointer of the galvanometer carrying at its end some device for puncturing the record sheet or a pen moves across the paper. The pointer is pressed down on the record sheet every minute, and makes a point corresponding to the deflection of the galvanometer (*i.e.*, the temperature at that instant).

The two methods of thermo-couple measurement may be compared as follows :—

The advantages of the galvanometric method are portability and simplicity; the disadvantages closeness of scale, and the fact that an error is introduced by the variation in resistance of the couple.

The potentiometer method has the advantages of an open scale, and that no error is introduced by the resistance of the couple. The only serious disadvantage is the fact that the apparatus must be worked in a laboratory, and requires a trained observer.

Professor H. L. Callendar has designed a recording potentiometer for use with thermo-couples which I will explain later.

Before leaving the thermo-couple I must mention the extremely ingenious method designed by Dr. Stansfield for obtaining sensitive records of recalescent points. A description of this was published in the fifth report of the Alloys Research Committee ; the illustration, fig. 6, is from this report.* Two junctions A, A are employed ; one is placed in the piece of steel, B, and the other in a piece of fine clay or copper, C. A sensitive galvanometer G, connected to both thermo-junctions, measures on a large scale the difference between the temperatures of B and C. Magnified records of the evolution of heat in B can thus be obtained, which are

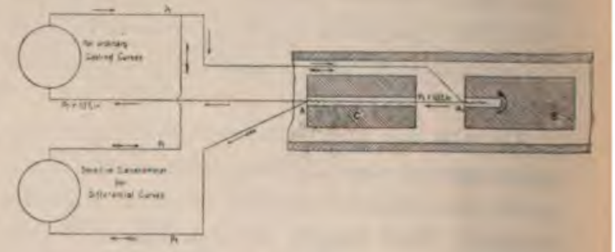

FIG. 6.

Diagram of Stanfield's method of obtaining sensitive records of recalescent points.

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* Fifth Report of the Alloys Research Committee : Steel, by Sir William C. Roberts-Austen, Institute of Mechanical Engineers, Feb., 1899, p. 38.

not affected by the general fall of temperature of the system.

ELECTRIC-RESISTANCE THERMOMETERS.

The electric-resistance thermometer was first proposed by Sir William Siemens in the Bakerian Lecture of 1871, and it immediately came into general use in metallurgical work. Unfortunately, it was found that the pyrometer did not satisfy the fundamental criterion of always giving the same indication at the same temperature, and it was rather severely condemned by a committee of the British Association in 1874, who showed that these changes in resistance were due to chemical alteration in the platinum. These changes are very rapid if the platinum is quite unprotected, less rapid if the platinum is protected by a steel tube, and disappear if protected by a porcelain tube. All the volatile metals attack platinum readily, and silica and the silicates must be avoided. I recently experienced a striking case of the weakness of platinum in this respect. A thermometer was constructed, the outer covering of which was a nickel tube turned out of a casting, and presumably porous, The furnace gases passed through the nickel tube and rapidly destroyed the platinum. I am not quite sure what actually occurred, but chemical analysis showed the platinum leads to be largely impregnated with iron. It has been suggested that volatile nickel carbonyl was first formed, which combined with the iron tube of the upper part of the thermometer forming iron carbonyl, which, in its turn, combined with the platinum. Whatever occurred, the thermometer was rendered useless after comparatively little use. I mention this case in order to emphasise the care that should be taken to protect the platinum wires from noxious vapours when making accurate temperature measurements.

In 1886 Professor Callendar showed* that if the platinum is supported on a mica frame, in section that of a cross with equal arms, there is perfect insulation without any cause of alteration. He also showed that all joints in the wires should be made by fusion. Metallic solderings are volatile and attack platinum, and screw joints become loose. I cannot enter into a description of the classical work of Professor Callendar on this subject, but would refer anyone interested to a paper published by him in the Philosophical Magazine, February, 1899, entitled Notes on Platinum Thermometry, which gives an excellent summary of his work. The results of his researches—and they have since been confirmed by many workers—is to show that the platinum-resistance thermometer, if protected from strain and contamination, is practically free from zero changes over a range of 0 to 1,200 deg. C., and that it always gives the same indication at the same temperature. He also showed that different platinum wires agreed very closely in giving the same value of any temperature on the platinum scale, although they differed considerably in the values of their temperature co-efficients.

Professor Callendar pointed out that if R_0 denote the resistance of the spiral of a particular platinum thermometer at 0 deg. and R_1 its resistance at 100 deg., we may establish for the particular wire a temperature scale, which we may call the *scale of platinum temperatures*, such that, if R be the resistance at any temperature on the air scale, the temperature on the platinum scale will be $\frac{R-R_0}{R_1-R_0}\times 100$. For this quantity he employs the symbol *pt.*, its value depending on the sample of platinum chosen. In order to reduce temperatures on the platinum scale to the gas scale, it is necessary to know the law connecting "T" and "*pt.*" They are, of course, identical at 0 deg. and 100 deg., and experiment has shown that the formula

$$T-pt=\delta\left[\left(\frac{T}{100}\right)^2-\frac{T}{100}\right]$$

expresses the curve of the relationship between them in other parts of the scale. The value

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* Practical Measurement of Temperature. H. L. Callendar. Phil. Trans. Rog. Soc. A. 1887.

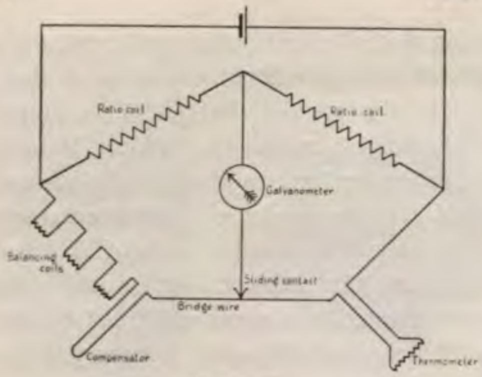

FIG. 7.
Diagram showing method of measuring temperature with resistance thermometer.

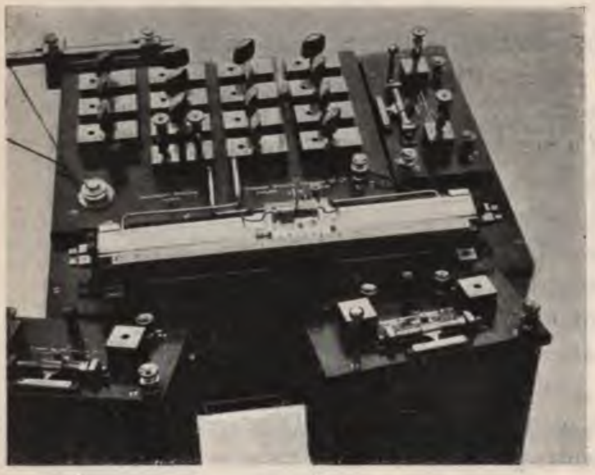

FIG. 8.
Callendar and Griffiths' Bridge for extremely accurate temperature measurements.

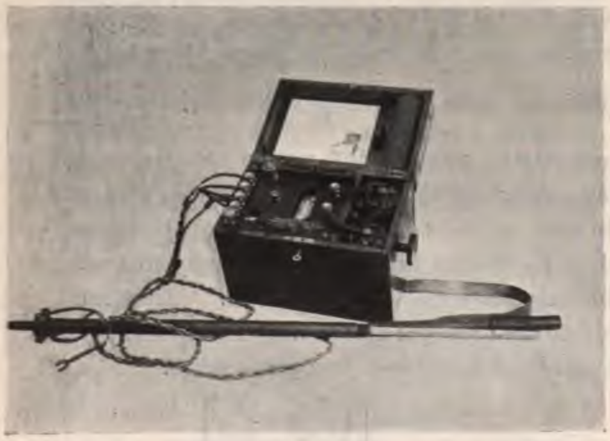

FIG. 9.
Whipple Temperature Indicator with Callendar and Griffiths' Resistance Thermometer.

of 8 depends on the purity of the platinum wire used ; it can be obtained from observations at three known temperatures. A table of corrections is used to convert temperatures on the platinum scale to those on the gas scale, or the instruments used with the thermometers read directly on the gas scale.

The platinum resistance-thermometer consists of a fine platinum wire wound on a mica frame connected by means of stout copper or platinum leads to terminals in the head of the thermometer. Two similar leads, but unconnected to the coil, pass through the whole length of the thermometer, and act as compensating leads. By this means no error is introduced by the variation of the temperature of the wires connecting the thermometer with the indicator or recorder. The diagram, fig. 7, explains the general arrangement for the use of Callendar and Griffiths' resistance thermometer. The thermometer coil forms one arm of the bridge, whilst the compensating leads and the balancing coils form the opposite arm, a pair of equal ratio arms being generally used.

If temperature measurements are to be made with a resistance thermometer to a high degree of accuracy, a specially designed Wheatstone bridge and a sensitive galvanometer must be employed. Several of the leading features of the well-known Callendar and Griffiths' bridges can be gathered from fig. 8, which is an illustration of a bridge recently made for extremely accurate temperature measurements. For general commercial use, the author has designed a bridge (fig. 9) which is a modification of one invented by Professor Callendar and Principal Griffiths, in which the temperature values are read directly in degrees C., and rapidly varying temperatures may be followed. The instrument is especially useful for measuring the temperatures of boiler flues.

(*To be continued.*)

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[*] Phil. Trans., Vol. 203, pp. 343-384.

A paper read before the Cleveland Institution of Engineers, Middlesbrough.

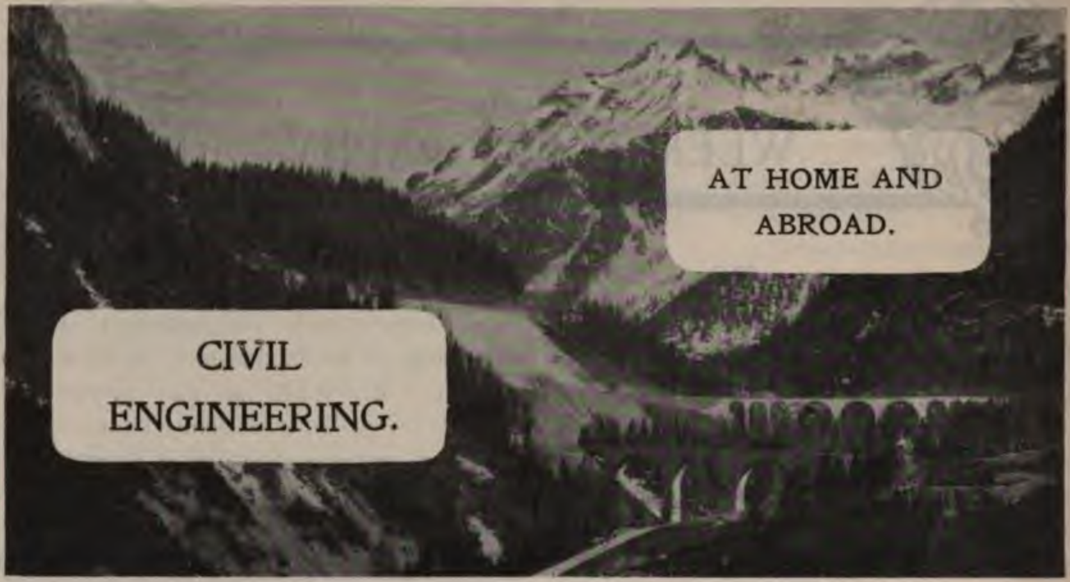
OUR WEEKLY BIOGRAPHY.

MR. J. M. WHILE, M.Inst.C.E.

MR. J. M. WHILE, M.Inst.C.E., Member of the Council of the Iron and Steel Institute, received his professional training at the works of Messrs. Fothergill and Hankey, and with Messrs. John Brown and Co. In 1872 he accepted an appointment at the Gorton works of Messrs. Bolckow, Vaughan and Co., where he was responsible for the contract for the whole of the manufacture of steel rails. His next position was that of manager of Messrs. Bayley and Dixon's mills; he remained with this firm for a period of five years, and then went to the Dowlais Iron Company. He occupied the post of general manager of the Darlington Steel and Iron Works for ten years, and for the last fourteen years has been general manager of the Barrow Hematite Steel Company. When at Messrs. Brown, Bayley and Dixon's he patented the system in general use to-day for the rolling of tram-rails; that is, the use of a vertical roll placed on the same axis immediately between the journals of the horizontal rolls. He invented and adopted skids for the purpose of conveying rails along the hot bank, which have now become general. Mr. While has also invented and adopted several other mechanical improvements, which are at the present time in operation at the Barrow Company's works.

MR. J. M. WHILE, M.INST.C.E.

In addition to the many improvements he has effected, he has rebuilt, on the most modern lines, a very excellent Bessemer shop, which, with the heated pits and conveyance to the rolls, saves the firm about £40,000 per annum. The Siemens' furnaces have been enlarged from twenty to fifty tons each. A complete electric installation has been put in, consisting of one 100, two 250 and one 500 kilowatt dynamos. he last extension of note is one which has been carried out in record time, viz., the full equipment of eight Babcock and Wilcox boilers, engine-house, a set of blowing engines, pumps and condensers, all of which, including the building of the engine and engine-house, has been completed in nine months.



CIVIL ENGINEERING. AT HOME AND ABROAD.

AT its meeting on Tuesday, the Institution of Civil Engineers discussed the papers on "Alfreton Second Tunnel," by Mr. Ernest Frederic Crosbie Trench, M.A., B.A.I., M.Inst.C.E., and "The Reconstruction of Moncreiffe Tunnel," by Mr. Dugald McLellan, M.Inst.C.E., the succeeding paper being "Surface Condensing Plants and the Value of the Vacuum Produced," by Mr. Richard William Allen, Assoc.-M.Inst.C.E. A students' meeting will be held this evening, at 8 p.m., when the papers to be read are: "Morecambe Sewerage: Method of Laying a 15-in. Cast-iron Sewer under the London and North-Western Railway," by Mr. F. D. Flint, Stud.Inst.C.E., and "The Reconstruction of Bow Bridge over the River Lea," by Mr. H. M. Rootham, Stud.Inst.C.E. Mr. G. M. Lawford, M.Inst.C.E., will occupy the chair. Details of Bow Bridge appeared in a recent issue of PAGE'S WEEKLY.

At a meeting of the Metropolitan Water Board, the Works and Stores Committee presented a report in which they stated that the chief engineer had submitted to them a scheme which provided for an interchange of water between the Southwark and Vauxhall and Lambeth districts, whereby a better pressure could be given to the higher areas of those districts with a very great economy of pumping and other expenses. The scheme had the advantage, moreover, of being a part of a larger scheme by which the two districts in question could be worked together with greater benefit to the public. An estimate of £30,630 for the necessary works was approved.

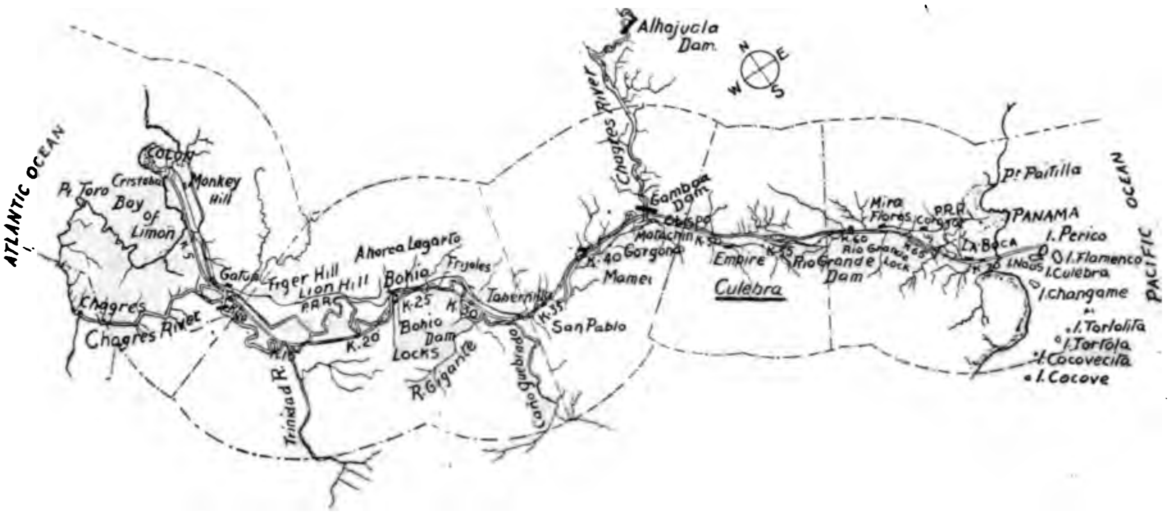
A Times correspondent writes: Instructions have been issued for work to commence forthwith upon the great irrigation scheme for the Punjab which has been sanctioned by the Secretary of State for India. The total cost will be 782 lakhs of rupees (£7,213,333), and it is hoped to complete the undertaking in about nine years. The Upper Jehlam and Upper Chenab canals are to be taken in hand first, as the work on the third project, the Lower Bari Doab Canal, is easier, and the canal will be dependent for its water supply on the other two. The total area to be irrigated by these works will be some two million acres, the people of which will thus be protected from famine, and a large part of which, now sterile, will be opened up to irrigation. The scheme for converting Wular Lake, in Cashmir, into a reservoir to feed these canals does not form part of the project actually sanctioned, but it can be taken in hand at any time hereafter as an addition, the estimated cost being only 49 lakhs of rupees. Its principal use will be to increase the supply of water available for irrigating the cold weather crops, which are especially important in the Punjab.

Mr. John Barrett, the United States Minister at Panama, discusses the Isthmian canal and its problems in the current number of the American Review of Reviews. In justice to Mr. Wallace, the chief engineer, and in order to correct some of the newspapers, which have unfairly assailed him for advocating a sea-level canal, and have quoted him as saying that such a waterway would cost $300,000,000 and occupy twenty years in construction, Mr. Barrett calls attention to the fact that the chief engineer has not yet advocated either a sea-level or a high-level canal, and has not yet submitted any final figures as to the cost or time of construction. These stories and criticisms emanate from the statement he made before the Congressional Committee when they questioned him during their recent visit to the Isthmus. If this official report, later on submitted to Congress, is carefully read, it will be noticed that he himself did not make any final estimate or express any decided views. He simply informed the Committee what were the estimates and the conclusions for a sea-level canal that could be based on the figures of the former Commission, respectively of $300,000,000 and twenty years.

The Minister makes a brief reference to the much-discussed dams and artificial lakes which cut considerable figure in the plans of the Canal Commission. These are generally described as the Gatun, Bohio, Gamboa, and Alhajuela projects. The facts developed by the technical investigations of the engineers have practically eliminated all of these except the Gamboa dam. This will so restrain the waters of the famous Chagres River at all times, especially at the flood, that they will not flow into the canal so as to impede navigation or fill it with sediment. It is, in other words, practically the solution of the Chagres problem. The greatest engineering difficulty heretofore emphasised in constructing a canal acress the Isthmus has been the presence of the Chagres River cutting into and across its route.

The dam at Bohio would require a gigantic structure, the highest in the world above bed-rock and the deepest below the surface. Its purpose would be to make a large lake reaching back to the Culebra section and entered by a series of great locks, thereby saving a long distance of excavation. In other terms, the channel of the canal would extend fifteen miles through an artificial inland lake which would at the same time impound the waters of the Chagres River and allow them to pass off through a spillway without damage to the rest of the canal. The Bohio is only a necessity for the 90-foot level in combination with the artificial lake, while the Gamboa dam would serve all levels below the 90-foot. The Bohio dam could only be constructed at an enormous cost and in the face of serious engineering difficulties, while if injured by earthquakes or by explosives in time of war it would render the canal useless.

The Gamboa dam, which impounds the waters of the Chagres to the east of the canal and in the mountains, also carries with it the important project of a tunnel through the lateral mountains which will keep the surface of the water in an artificial lake at such a distance below the crest of the dam as to provide sufficient capacity to take care of the maximum flow of the Chagres without causing the dam to overflow. The water drawn off by the conduits through the dam will generate electric power and also serve to reduce the level of the water above the dam. In case of a high-level canal, it can also provide the necessary water for the operation of the summit level. In the opinion of the best experts, the Gamboa scheme is entirely feasible, and will probably be followed, unless it is entirely given up, and a dam at Bohio constructed. The Alhajuela project is supplementary to the Bohio plan, and would simply form an additional reservoir farther up the Chagres to impound a portion of its waters.



MAP OF THE PANAMA CANAL ZONE, SHOWING THE LOCATION OF DAMS AND PRINCIPAL POINTS.

ENGINEER'S BOOK OF THE WEEK.

"OIL FUEL."

THE weight of expert opinion appears to incline more and more to the view that liquid fuel will, in future, be utilised in an increasing degree. The technical and mechanical difficulties which have stood in the way are by no means yet entirely overcome; indeed, as the report of the United States Fuel Board and the experiments conducted by our own naval authorities have made clear, the nature of certain problems yet to be solved has only now been really defined. The advocates of the use of liquid fuel have also to face the initial difficulty of supply. The Pennsylvanian fields are fast becoming exhausted, and unless another prolific source of supply is discovered in the near future, the application of liquid fuel will be considerably hampered, if not very seriously checked. The author of this book is not, however, disposed to be pessimistic in this respect.

Yet, assuming the question of permanence of supply satisfactorily answered, the general adoption of liquid fuel must necessarily be a slow process. Nothing like the full efficiency of coal has yet been obtained, and it is obvious that in this respect the case of liquid fuel is in its infancy. It need not be impressed upon the engineer that liquid fuel is an infinitely more delicate thing to handle than coal and that, consequently, the burners are by no means as efficient as they can be made. Even so, however, as Mr. North points out, the use of liquid fuel yields distinct economic advantages over coal, and in its application still more significant economies come to light.

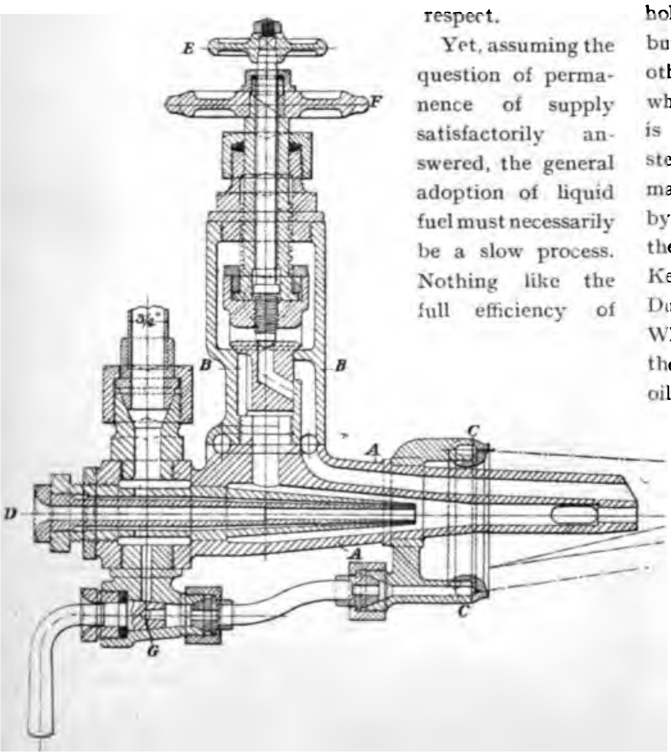


FIG. I. HOLDEN'S OIL-FUEL BURNER FOR LOCOMOTIVES.

One of the pioneers in the use of petroleum for steam raising was Mr. James Holden, the locomotive superintendent of the Great Eastern Railway, and the latest form of Holden burner is shown in fig. 1. The author gives a detailed description of the burner, but it is doubtless familiar enough to readers of **PAGE'S WEEKLY**, and it is enough to point out that *AA* is the coned body, *BB* the specially designed regulating valve, *CC* the hollow ring behind the nozzle which enables the Holden burner to dispense with the brick walls necessary with other devices, *D* the steam jet, *E* the valve wheel, *F* the wheel by the agency of which the main supply of fuel is first admitted, and *G* the cock which regulates the steam supply to the ring on the injector. Readers may be reminded of the special construction of the valve by the use of which very fine adjustment in the flow of the oil fuel is possible. The author also refers to the Kermode, the Körting, the Orde, the Swensson, the Durr, the Rusden and Eeles, and the Armstrong-Whitworth burners, all of which are illustrated in the book. It is admitted, however, that the perfect oil burner has yet to be devised, although the direct pulverisation of the oil is coming to be recognised as the proper method.

The most interesting chapters of the book are, perhaps, those on the use of oil fuel for marine purposes, naval and mercantile. In this connection, as indeed with coal fuel, if satisfactory results are to be obtained, a great deal depends on the arrangement of the furnace, and on this field the battle of the burners has again been fought. In order to save the coal which it is necessary to use to provide the steam for pulverising the oil experiments have been made with the use under the Meyer system. Fuel is

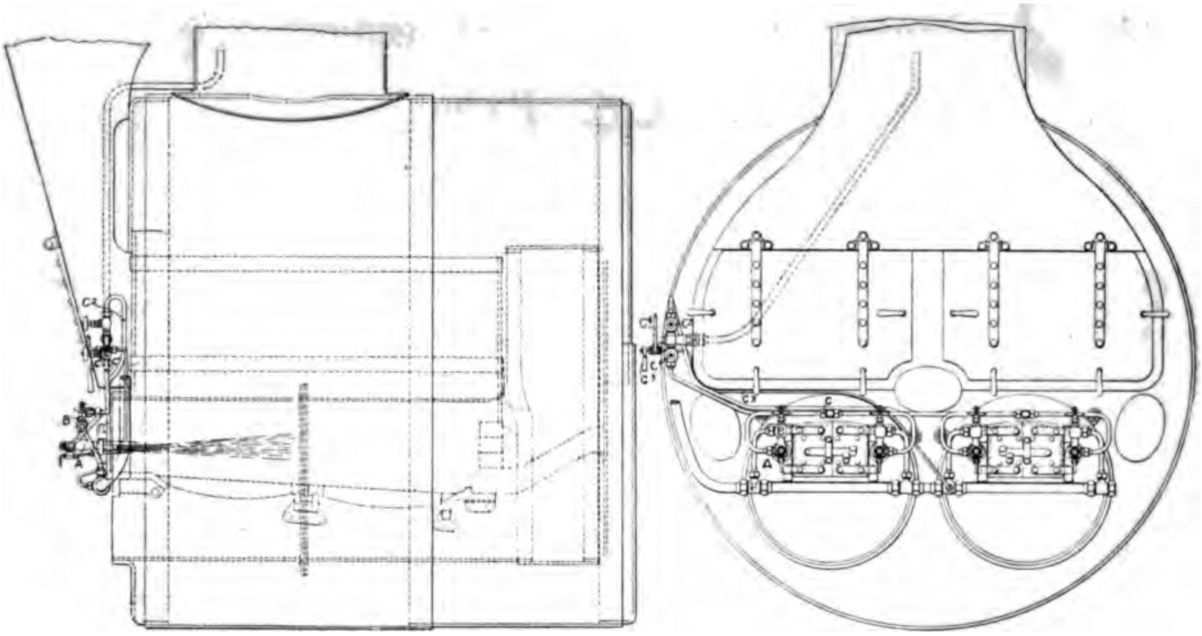


FIG. 2. ARRANGEMENT OF HOLDEN'S BURNER FITTED TO MARINE BOILER.

war vessel, and what has hampered the use of oil fuel by the British navy is, no doubt, the fact that while there is an ample coal supply in these islands, oil fuel is geographically out of reach. Latterly, however, naval authorities are seriously grappling with the oil fuel problem, with results which are likely, it is thought, to lead to important developments. It is thought that liquid fuel ought to be successfully used on torpedo boats. The evaporative duty required from the boilers of destroyers is greater than that required from the boilers of any other type, and, as the author reminds his readers, while it is possible to burn enough liquid fuel to produce the required duty in boilers hitherto using coal at natural draught, or even coal at moderate forced draught, difficulty has been found in burning enough oil-fuel with burners of the destroyer type to produce the same duty as that realised under coal at great air pressure. The question of economy in fuel in destroyers when at full power is of comparatively little importance; but the production of the maximum power is essential, and the further experiments now in progress will probably solve the difficulty. The experiments conducted by the Liquid Fuel Board has shown that it is now possible to force the combustion of oil, and that the greatest evaporation per square foot of heating surface secured with coal can be greatly exceeded by an oil installation of modern design. The problem of successfully installing an oil fuel appliance on board a warship, as Mr. North points out, grows more complicated as it is further investigated. The arrangement of Holden's burner fitted to a marine boiler is shown in fig. 2.

The appendix contains a series of tables showing the results of tests made by the United States Liquid Fuel Board in a Hohenstein water-tube marine boiler under forced and natural draught, and using air burners and steam burners.

A word may be said in conclusion as to the use of oil fuel for metallurgical and other purposes. It should, the author believes, form an unequalled medium for smelting operations; the chief objection being that of cost. Various forms of smelting furnaces designed for the use of oil fuel are described, but, as the author points out, although the smelting of iron ore by the use of oil fuel has often been suggested, the attempts made have so far been neither mechanically nor commercially successful. In the blast furnace, if coke or charcoal should be entirely replaced by oil, the charge would, in all probablity, become too dense to allow the combustion gases to escape freely.*

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* "Oil Fuel: Its Supply, Evaporation, and Application," by Sydney H. North. With numerous illustrations."—Charles Griffin and Co. Price 5s. net.

Automatic Signalling Arrangements on the District Railway.

IN anticipation of the more strenuous conditions caused by the shorter headway planned, the District Railway Company has had installed a system of signalling fcr which great improvements over all earlier systems are claimed. This plant presents features of more than ordinary interest, and is, moreover, the first installation of its kind in this country.

The section of line between Hanger Lane Junction and South Harrow, has now been worked electrically by the District Railway for over a year, with results that augur well for its success on the more important sections of the line. The length of this trial section is about five miles of double track, and it is divided into block sections, varying in length from 1,400 ft. to about 3,500 ft. On the District Railway generally there are both positive and negative insulated traction rails; the running rails not being used for the traction current. The space between stations is usually divided into two blocks, that is, a "starting" and a "berth" block, and the signalling is on the "normal clear principle.

The signals themselves are of the ordinary mechanical type, and in no way specially adapted for power or automatic working; consequently, they are being replaced by special arms with Westinghouse electrio-pneumatic signal motors, fitted close under them, and the ordinary counterweight abolished for one directly on the signal arm as shown in the illustration (fig. 1). The motors are enclosed in cast-iron casings, and, being essentially strong and simple, are not affected by climatic conditions. They are controlled by small pin valves, worked by means of electro-magnets in the local signal circuit. Signal cabins are required only at each end of the branch, or where there is a cross-over road; in the latter case they are normally closed, being opened only when required.

An automatic stop prevents trains from over-running home signals (fig. 2). This consists of an iron arm between the track rails actuated by a compressed air motor acting in unison with the adjoining signal motor. When the signal goes to "danger" this arm is elevated to a position in which it engages with a cock on the air brake system of the train; thus the brakes are instantly and automatically applied if, for any reason, the driver should run past the signal.

No great saving in first cost need be expected from an automatic installation, as the initial expenditure would probably be quiet as great as that incurred in laying down the mechanical system. The working expenses, on the other hand, should be very much reduced, the saving in labour being a most important item, and the cost of renewals and repairs trifling. But, undoubtedly, the greatest advantage of an automatic system is its suitability to the requirements of a very frequent and quick service. The blocks may with facility be made as short as is compatible with the running speed and brake power cf the trains. The strain on the signalmen, inseparable from such a service, is abolished, and the safety of passengers is thus independent of the personal equation.

The principles of the system may be best understood by reference to the diagram (fig. 3). One of the track rails is electrically continuous through the

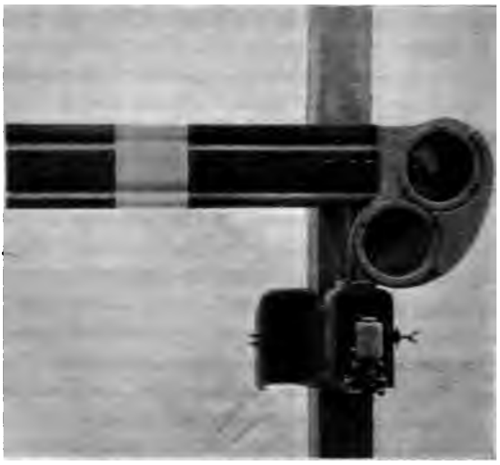


FIG. I. NEW SIGNAL ARM.

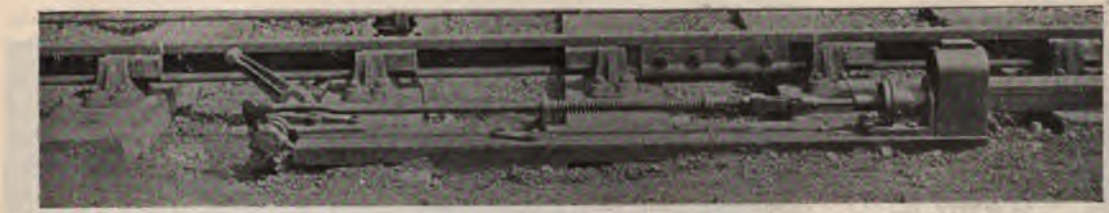


FIG. 2. AUTOMATIC STOP, PREVENTING TRAINS FROM OVER-RUNNING HOME SIGNALS.

whole length of the plant, and constitutes the positive conductor from the generator to the individual track sections. The other rail is cut up into block sections by means of special rail joints insulated with fibre. All uninsulated rail joints are bonded to ensure electrical continuity. Power for the operation of the system is generated at 65 volts pressure by motor generators placed centrally, the negative terminals of which are connected to an insulated negative main running the entire length of the system. This main is connected to each section of the sectionalised track rail at a point near the latter end of the block, *i.e.*, the end at which the train leaves, as distinct from the end at which it enters. It will be seen, then, that there is a potential difference of approximately 65 volts. between the continuous—positive—rail and the insulated negative main.

Resistances are interposed in the connections between the negative main and the sectioned rail, which reduce the potential difference between the rails to, in the present instance, from 3 to 6 volts, according to the length of the block and various local conditions.

Let us now consider the circuit for a single block unoccupied by a train. The current from the positive brush of the dynamo flows along the continuous rail, and thence through the two relays, one at each end of the block, and through the ballast between the rails, all in parallel, to the sectioned rail. From this it flows through a relatively large resistance to the negative main and back to the machine.

Now, suppose a train enters the block. Obviously the current now flows through the practically negligible resistance of the car wheels and axles from one rail to the other, and the relays are shunted, with the result that the signal is allowed to go to danger.

The "track battery" resistances connected between the negative main and the sections of the sectionalised rail prevent the generator being short-circuited when the track circuit is shunted by the axles of the train. In fact, these resistances bear such a relation to the combined resistance of the road bed from rail to rail and the two relays, all in parallel, that the shunting of the track cuts out only a small percentage of the total resistance of the circuit. Thus the current increase in a circuit, when shunted, is not great; this is important, as it is advisable to keep the track potential as nearly as possible constant. An increase of the total current, resulting from the blocks being occupied by trains, affects the potential between the rails of unoccupied sections, increasing the transmission loss in the negative main.

The loss in the continuous track rail may generally be neglected on account of its large section. Another circumstance directly affecting this track potential is the variation of the resistance of road bed according to weather conditions. Broken stone forms much the best ballast from an electrical point of view, and cinders the worst. It may here be mentioned, however, that though on several occasions recently the track rails on this system have been flooded, the operation of the signals has, we are informed, been in no wise interrupted.

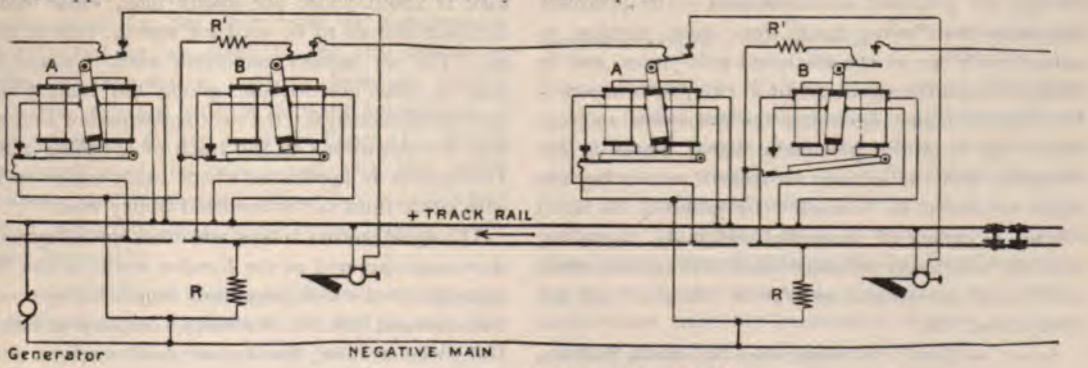


FIG. 3. DIAGRAM SHOWING CONNECTIONS.

Next we come to the consideration of the circuits of the track relays, which control the signal circuits. Fig. 3 is a diagram of the relay and signal magnet circuits for a single block. The track coils (see fig. 3) of the relays are permanently connected across the rails at that end of the block at which the relay is placed. Between the pole pieces a polarised armature is suspended from a pivot. This armature bears a winding of considerable resistance, and is connected between the positive rail and the negative main through a contact—operated by the track coil armature—which is closed when the track coils are energised. To the polarised armature is rigidly connected an arm which actuates a contact, the function of which is to open or close the local circuits controlling the signal motors The operation of the relays is then as follows: When a difference of potential exists in the normal direction between the rails, *i.e.*, when there is no train on the block, the relay track coils are excited and draw up the armature, which closes the circuit through the polarised armature. The polarised armature is then attracted to one of the poles of the relay, and, swinging over, closes the contact in the local signal circuit.

As already mentioned, there are two relays in each block, one at each end: these are duplicates, and operate normally in a precisely similar manner, each working a contact in the local signal circuit. These contacts are in series, as shown clearly in fig. 3—relays *a* and *b*—and, unless they are both closed, no current can flow through the signal magnet, and the signal will therefore remain at "danger" by gravity.

The position of the apparatus when the block is empty has been indicated above: both relays energised, the local signal circuit closed, and the electro-magnetic valve operating the pneumatic signal motor consequently open, admitting compressed air to the motor, which holds the signal arm "off." As soon as a train enters the block, the relays are short-circuited by the car axles, and thereby de-energised, permitting their armatures to drop, and thus breaking the circuit through the polarised armature coils. The polarised armatures then swing back from their position in contact with one of the track-coil pole-pieces, and in doing so break the signal circuit at two points in series. The electro-magnet operating the admission and exhaust valves of the pneumatic signal motor is de-energised, and the exhaust is opened, permitting the signal to return to "danger" by gravity. It is, of course, a canon of successful automatic signalling that any interfering influence must, if it has any effect at all, cause the signal arms to go to "danger," and not bring them "off."

So far, so good; but experience has shown that the greatest obstacle to the success of automatic signalling on electric railways in particular, is the liability of the relays being operated by extraneous currents so as to cause a false "clear" indication when danger should be shown. The particular claim of the system under consideration is that it is impossible for an extraneous current, from whatever source, to bring the signal arm to the "off" position when it should stand at "danger."

The main source of extraneous currents affecting the signals is the 500-volt traction power circuit, and when, as is the case at Ealing, the track is not used as a return, the presence on the block sections of current from this source is abnormal. Faulty insulation of the train equipment, positive and negative rails, positive cables, etc., is the most frequent cause of leakage to the track rails. Whether currents other than the signalling current on the track rails are normal, as would be the case were one of the track rails used as a power return, or abnormal, as in the present case, is immaterial, such currents would be equally disastrous to a susceptible system, and are, it is said, impotent to affect the system considered. Faults in the main power circuit occur with sufficient frequency to demand the closest attention on account of the disorganisation of the traffic which they may cause, but even if they were rare, the least liability to give false signal indications of safety would forfeit all claims for consideration.

Although in the present system, it is possible for the extraneous currents to energise either one or both relays while the train is in the block, these latter are so interconnected that is is not possible for them both to be energised in the normal direction at the same time by extraneous currents.

A few words may be added with regard to reliability. The only parts of the mechanism which can be described as in any way delicate are the relays, and these are enclosed in weatherproof boxes, where they can readily be examined at intervals. The air pressure used is about 70 lb. per square inch, which enables compact motors to be used for signals, points, stops, etc. The air motors employed, work, we are told, year in year out without giving the least trouble. The piping is compact, the electrical wires few and small, and the alterations to the track of a trifling nature. The system is applicable where track return is used with either third rail or overhead trolley wire.

The signal motors, relays, and other special apparatus were manufactured at the London works of the Westinghouse Brake Company, and supplied direct to the Underground Electric Railways Company of London, Ltd., who installed the apparatus themselves.

"POWER."

(*A Series of Weekly Notes continued from page* 367.)

THE boilers of locomotive engines, although subject to various restrictions, in the way of dimensions and weight, are, nevertheless, beyond all comparison most energetic steam producers. The principal reason for this is, of course, the intensity of the steam blast in the chimney, which enables them to burn usefully an enormous amount of coal per unit of grate surface, although there are two other causes—already touched upon—which in lesser degree contribute to the efficiency of this type of boiler. First, the relatively clean heating surfaces, as compared with boilers having a more sluggish rate of combustion: there is little soot deposited in the firebox plates, or tube surfaces, of an express locomotive travelling at full speed; and, secondly, the shaking to which these boilers are subject while in active use, which has the effect of promoting the escape and discharge of the globules of steam as they form on the heated surfaces.

It must not be forgotten that the fierce combustion in the locomotive firebox is not maintained for any great length of time; and is, as a rule, alternated with more or less lengthened periods of inaction, during which the grate-bars and air spaces may be thoroughly cleansed, and the fire skilfully rebuilt in preparation for the next spell of high-pressure activity. And here we come to the real distinction betwen the locomotive, and the loco-type boilers. The latter, differing little in outward appearance, is commonly in use for ten or twelve hours at a stretch upon six days of the week; and with less skilled attendance, and inferior fuel, demands a very different scale of proportions from its fire-eating brother of the railway locomotive.

In proportioning a locomotive boiler so as to give the best efficiency, regard must be had to the conditions under which the boiler is to work. If we want a boiler which is to develop the maximum of power in a limited space, if we are prepared to put a highly-skilled fireman in charge, and to allow the requisite intervals for cleaning the fire, and washing out the boiler, we turn unhesitatingly to railway practice, and put in a boiler whose tube surface is nearly or quite sixty times the grate area, knowing that the tremendous energy of the blast demands a corresponding increase in the amount of tube-surface required to absorb the heat on its way to the chimney.

If, on the contrary, we are designing a boiler for stationary purposes, we fall under a different set of conditions at once. In order to compare the different classes and sizes of boilers, it is desirable to fix upon a unit to which all the dimensions of any boiler may be referred; and this unit may conveniently be taken as one square foot of grate area. From this, as a basis, we may proceed to determine the extent of surface in firebox and tubes, which will best fulfil the requirements of the service for which the boiler is intended.

If we examine the proportions of ordinary stationary, or loco-type, boilers by several leading makers of this class, we shall find that taking all-round sizes, the average of a large number of examples will give the ratio $\frac{\text{Firebox heating surface}}{\text{Grate-area}}$ as very closely in the neighbourhood of 5, and the ratio $\frac{\text{Tube heating surface}}{\text{Grate-area}}$ averages about 23⅓. Whereas, in the case of thirty locomotives boilers taken from the leading British railways the ratio of firebox heating surface to grate-area averages 5·86, which does not differ widely in itself from the first-named range of boilers, but is accompanied by an average ratio of tube-heating surface to grate-area, of more than double that found necessary for the stationary loco-type, viz., 58·35, and similar ratios taken from the locomotives of nine American railroads show 5·66, and 59·61 respectively.

SCIENCE IN THE IRON FOUNDRY.

By J. E. Stead, F.R.S., F.I.C.

BY the term Science, as applied to the iron foundry, is meant the exact knowledge of things relating thereto, which has been proved by demonstration. During the last thirty or forty years metallurgists have been steadily advancing in knowledge as to what is right and wrong in the fundamental principles, particularly in connection with the metallurgy of steel. It is unfortunately a fact, however, that, until within recent times, the iron foundry has not received the attention which it deserves; there is, however, a good deal of information regarding the correlation of chemical analysis and mechanical properties of cast iron to be found in many publications both in Europe and in America.

Although science in the foundry may be said to embrace all the facts relating to foundry practice, it is not my intention to dwell upon more than the effect of metals and metalloids on cast iron, leaving the consideration of the effect of varying casting temperatures and other matters for future communications.

THE MIXING OF METALS.

The analyses of different classes of metal castings show that there is great variation in composition, but that generally speaking there is a suitable analysis for every class of casting. By this is meant that chemical analyses of several of the same class of first rate castings, which have been proved by long and useful service to be excellent, do not vary to any great extent. This being so, it should always be the aim of iron founders to work synthetically or to build up by proper mixture of metals, what practical experience and chemical analyses have shown to give the best results.

There is much to be said in favour of the old-fashioned method of mixing metals employed in the more carefully conducted works, in which a large number of brands and qualities of iron are kept in stock, and are mixed in the proportion which long and painstaking observation of the foreman foundryman has proved in practice to give the very best results in each class of castings. Indeed, it is the castings made by this method to which analysists were obliged to go in order to ascertain what was the best chemical composition, and thus to obtain their standards.

It was this method of mixing which prevailed in the early days of steel making by the Bessemer process, and provided the foreman had the requisite knowledge, and was allowed to have the almost infinite variety of pig irons he demanded, he obtained good and constant results.

It was believed at that time that every brand of Bessemer iron had some peculiar property distinct from that of other brands, and that good steel could only result from their proper blending. I have met steel blowers thirty-four years ago, who maintained that it was impossible to make good steel from one brand only. They had no knowledge of the effect of silicon and sulphur, and they had, without doubt, found by bitter experience that no reliance could be placed upon the iron sent from one maker only. The metal at one time would blow far too hot, at another time so cold as to "set" in the ladle, and even when it behaved properly in the converter, it would sometimes break up at the hammer, and when finished be excessively cold-short, variations which would naturally be expected, even at the present day, if there were no analytical control. Considering that these old-fashioned Bessemer steel makers should have elaborated the only possible system by which regularity could be obtained, it is without doubt, greatly to their credit, for where there were no accurate analyses of the iron available it was absolutely necessary to use a mixture of many different brands of iron to obtain anything like regularity. With our present knowledge, we know that all the brands would vary at that time just as they do to-day in different deliveries, that some would contain more and others less than the normal quantities of the essential elements, and that by mixing the irons together the variations were averaged.

A PERSONAL REMINISCENCE.

In my own experience, when at the Gorton Steel Works of Messrs. Bolckow Vaughan and Co., Ltd., the "blower" insisted on having the usual mixture of irons from the West Coast to work with the iron supplied from the Witton Park Works near Bishop Auckland, which it was imperative he should use alone without any admixture and it took much time to convince him that it was not necessary to have different brands, provided the composition of the East Coast Iron approximated to that of the mixture he regarded as suitable for blowing. Knowing the real significance of this preference I eventually persuaded him to try mixing small quantities from six or seven separate stacks of the same brand of Witton Park hematite, instead of taking each charge from one stack only. This he did, but unfortunately for the chemist the average mixture, so made, blew very hot in the converter. It often happened that much silicon was left in the steel, and the rails produced from it were brittle in consequence. The blower explained that this was due to the iron being freshly made, and that if it were kept in stock for six months so as to get a good coating of rust upon it, "the *sulphur* would be removed, and the iron would then blow all right and make good steel." Knowing as I did that the extra heating in blowing was due to silicon, I suggested putting cold scrap steel into the cupola and melting it with the metal (for the simple reason that it was impossible to stop the works for six months to allow time for weathering the metal). His answer was somewhat startling for he informed me "that every piece of steel put into the cupola vanished up the cupola stack and none of it ever got into the converter." He was, however, persuaded to charge cold scrap into the converter, and in this way we obtained steel free or nearly free, from silicon. So convinced was he, however, that rusty iron was an advantage, that it became his practice to project water from a hose pipe upon the stacks of iron so as to accelerate rusting. This behaviour on his part, based on a long previous experience in Bessemer's own works, led me to investigate whether, or not, weathering was an advantage in removing sulphur. I made a special experiment to test it, but found that the proportion of the elements in the weathered iron were the same as in the original pig, and that no sulphur was removed. There was, however, less sand on the outside of the weathered pigs, and a considerable coating of rust. It occurred to me that the rust or oxide of iron might be responsible for removing some of the silicon in the iron when it was being melted in the cupola, and on actual trials being made with old and new pigs, with identical quantities of silicon in each case, it was found that the rusted iron gave melted metal with a little less silicon than was present in the new-made iron. It appeared from this, then, that the blower had some ground for wishing the iron to be weathered. It was not sulphur, however, but silicon which was removed as the indirect result of weathering.

By making iron with less silicon the difficulty was entirely removed, and with it the prejudices of the blower, but in practice it was still found most desirable to take the iron from many stacks of the same brand rather than from one of two stacks only.

I have given in detail this personal reminiscence as showing what the prejudices were at that time, and what difficulties there were in removing them from the minds of men who, having practised under an old regime, could not, for some time, at least, appreciate the value, to himself and his work, of new ideas in which the analysis of the metals played an important part. As can most naturally be expected during the transition period, whenever the steel did not turn out satisfactorily the blame was put upon the chemist, and upon the new system, and there was often great desire expressed to go back to the older system.

What I have said may, perhaps, cause those who make good Bessemer steel to-day to ridicule the methods of the old system, and the prejudices held by practical men at that time, but I, for one, have great respect for these workers, and also for men in the iron foundry to-day who, having only their own past experience to guide them, naturally prefer to depend upon what they think they know, than accept what to them is incomprehensible.

THE APPLICATION OF CHEMICAL SCIENCE TO THE FOUNDRY.

The experience of the old type worker in the Bessemer shop, whose duty it was to melt mixtures of metal in the cupola, is not without value to modern foundry men, many of whom cling so fondly to the data they have laboriously obtained during a life's experience. It is unfortunate, however, that the pig iron maker cannot always supply him with pigs of constant composition, for although they may be equal in the appearance of the fracture, and the grading may be perfect, yet, for all that, they do vary to a very great extent in the amount of silicon and sulphur present, and the results obtained in the foundry necessarily vary to a corresponding degree. It follows that mixtures of one or two brands, which give good and perfect results at one time, will give imperfect work at another. The founder's experience is not at fault. It is the variable nature of the pig iron supplied to him which renders it of uncertain value. For that reason it behoves every foundry foreman to demand that he shall be supplied with the necessary properly laid out stock yard, and to have analysis of every stack of iron on the ground, and then by so supplementing his valuable practical experience and knowledge he will be enabled to make his mixtures to the best possible advantage.

Much has been written from time to time on the requisite composition of castings for various purposes, and quite recently Professor Turner and Mr. Percy Longmuir have published several articles, lectures and papers on the chemical, physical, and microscopical side of foundry practice. It is, however, in America, where the greatest activity prevails in the application of chemical science to the foundry. In that country there are several Foundrymen's Associations and a Journal devoted exclusively to foundry practice which generally contains reports of deliberations and discussions of these societies, as well as reviews of work done in other countries.

Although more is heard of what is being done in the States than of works' practice at home, it is a fact that steady progress is being made in England, Scotland and Wales, which, although not talked of, is nevertheless bound to be felt on account of the better work turned out. My object is to direct attention of founders and others to certain necessary and fundamental conditions for carrying out foundry practice to-day, and to suggest a few definite lines which metallurgical chemists in foundries should follow in order that their services may have the maximum value both to themselves and their employers.

Those who prefer to work, on what may be called the hand-to-mouth principle, can have little or no use for a chemist, and cannot possibly make the best of progress, for they are completely at the mercy of the sender of the pig iron, who, if he supplies foundry iron of the grades specified, may send material with greatly varying properties.

Many works are so arranged that it is impossible to keep stocks, and they have no alternative but to feed their cupolas direct from the trucks or from the twenty or thirty tons of metal they have room to stock.

NEED FOR ANALYSES.

Their remedy is to demand an analysis from the maker of each brand, and accept only such iron as contains the specified quantity of silicon, etc. It has been the practice of hematite pig makers to test each cost and to stock according to the analysis, and there should be no difficulty in doing the same thing at furnaces making foundry iron.

Many furnaces in the future are likely to be driven much more rapidly than is the practice to-day, and as rapid blowing tends to the production of iron low in silicon, if such iron be sent out indiscriminately with the same class of iron made in the more slowly driven furnaces, the result will be chaos in the foundry.

Up to the present, foundry pig has been stacked, when put into stock for warrants or other purposes solely according to the grade of the fracture and not to analysis. I maintain that the time has come when this old time custom must be swept away, and it is the buyers of foundry iron only who have the power to effect the change, for by demanding chemical composition as well as fracture numbers, the makers will be obliged to meet them, but certainly cannot be expected to do so, if it is not asked for.

When ordering pig metal, it is very important that the analysis be demanded, and also where possible, that each day's delivery shall be taken from a single cast of iron, or if more than a single cast is sent in any one delivery, to have the trucks ticketed, so as to show the cast and analysis.

ARRANGEMENT OF STOCK YARDS.

The stock yards should be arranged in such a way that there is easy access from the cupola to the stacks of pig, and equally easy access from the railway sidings. Where many brands are used, the area required will necessarily be greater than when a small number are stocked. The arrangement of the stacks must depend upon the space available, and the work done. The system I should prefer is to make long rectangular narrow stacks, say 20 ft. to 30 ft. in length, 5 ft. in width, and 5 ft. in height. These should run parallel with the railway. In unloading the iron from two or three trucks at a time, the pigs should be spread equally over the 25 ft. by 5 ft. area, and this system should be continued when laying down the iron from sets or other trucks of the same brand, until the height of the stack of 5 ft. is reached. Samples having been taken, these should be sent to the laboratory for testing purposes, and no iron should be used from any stack until its average composition is known. In taking metal from them to melt in the cupola, what is removed should represent an average of every layer. This is done by working from one end of the rectangular heaps to the other.

When the first stacks are being worked up, duplicate stacks should be made, preferably opposite those of like brand, on the other side of the tram or railway.

The scrap iron should be stocked according to its fracture, and average analyses be made of the stacks laid down. Two separate stacks should be sufficient, one of good grey heavy scrap, and one for small rusty material.

(*To be continued.*)

Read before the Cleveland Institution of Engin

PNEUMATIC DRILLS.

Improvements introduced by the Consolidated Pneumatic Tool Company, Ltd.

THE Boyer hammer, fitted with hand or automatic rotating device (figs. 1 and 2) are designed for various classes of plug and feather work. They are made in three sizes, adapted for light medium, and heavy drilling, the best results being secured with an air pressure of 80 lb., at which pressure the hammers consume approximately 20 cubic feet of free air per minute. The difference in the two types lies in the rotating attachment. The hammer used is an improved type of the Boyer chipping hammer, No. 1.

The light weight of these machines admits of their being easily held by hand, and they are, therefore, available for either top or side-line work. As many as 131 holes $\frac{5}{8}$ in. in diameter by 3 in. deep have been drilled in hard granite, with one of these machines in 140 min.; this time, including the lining, changing of drills, etc. On account of the light rapid blow employed, the drills do not require resharpening so frequently as in hand-drilling, and as many as 20 holes have been drilled without resharpening the bit. Type A of this hammer can be used to advantage with a special snap for copper stay riveting, the average time for knocking down $\frac{7}{8}$ stays being about 45 seconds. The improved rock drills which the Consolidated Pneumatic Tool Company, Ltd., are just placing on the market are a combination hand and tripod rock drill, which combine features not as yet anticipated in similar machines now in use, including light weight, rapid stroke, compactness, and economy in air consumption, and adaptability for use either by hand or with a tripod. The device which they possess for freeing the hole from cuttings is a tube which envelops the drill bit and which, by means of a blast of cold air running through it, completely clears the hole of all obstructions. This arrangement is extremely valuable in cases where the class of rock being drilled does not necessitate the use of water, though they can be adapted for water connection, using hollow steel. The rock drills are very simple in construction, containing altogether only some 26 parts, all of which are made of hard tool steel—a radical departure in the manufacture of this type of machine. Owing to its light weight, the drill has been used by divers under water for submarine excavation work, the only alteration necessary being to make provision that the exhaust shall be discharged above water-level.

This machine is made in two sizes, weighing respectively 45 and 25 lb. The larger size is shown in fig. 3.

The torpedo rock drill (fig. 4) is a light, yet powerful, machine, which can be driven by either steam or air; it is made in three sizes, the diameter of the cylinder being $2\frac{1}{4}$ in., $2\frac{3}{4}$ in., and $3\frac{1}{4}$ in., and the weight of machine 120 lb., 195 lb., and 310 lb. respectively, their respective capacities being $1\frac{3}{4}$ in., 2 in., and $2\frac{1}{2}$ in.

The valve mechanism of this machine is of an efficient yet simple character, and consists of a pair of Corliss type, located at either end of the cylinder and operated by means of a segmental rocker, actuated by means of a necking in the piston. This location of the valve reduces the

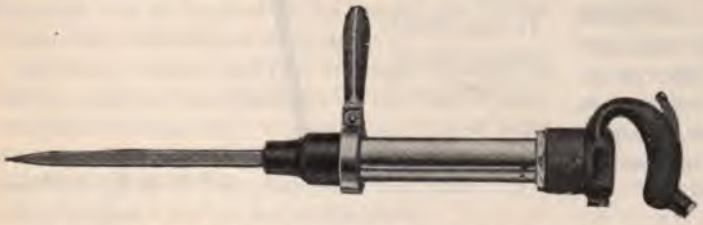


FIG. 1.—BOYER HAMMER WITH HAND ROTATING DEVICE.

Size $1\frac{1}{16} \times 4$, adapted for light plug drilling.
,, $1\frac{5}{16} \times 1\frac{1}{2}$, ,, medium ,,
,, $1\frac{5}{16} \times 3$, ,, heavy ,,

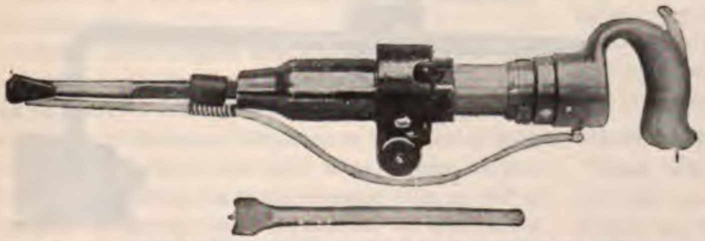


FIG. 2. BOYER HAMMER WITH AUTOMATIC ROTATING DEVICE.

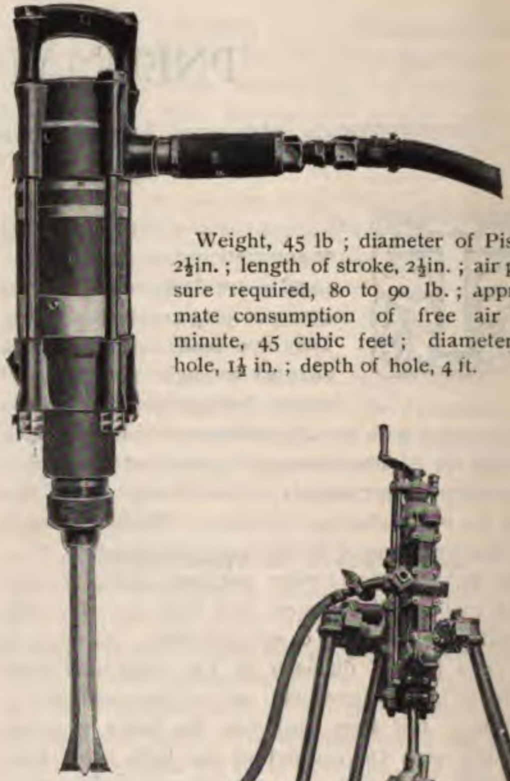
clearance space between the valve port, and the cylinder to the minimum, and the maximum port opening is obtained for admission and exhaust. The drill runs at full speed on any stroke from 2 in. to the maximum. The smaller size is handled, by one man, and is used with either tripod or column.

The Little Giant ore-boring machine (fig. 5), is a standard pneumatic drill, and either the No. 1 Little Giant or No. 8 Whitelaw type, can be fitted with a split nut attachment, arranged as shown in the illustration. It will drill in iron ore containing 35 per cent. to 50 per cent. of iron 1¼ in. holes at the rate of 3 ft. deep per minute, the maximum depth of holes being 6 ft. (this depth being obtained by using three drill bits). The split nut is of a simple and efficient construction. The halves of the nut can be readily replaced when worn out. When drilling, the links are locked in the closed position, and both halves of the nut are opened by one movement of the links, so that the screw bar can be at once withdrawn from the hole and a fresh bit inserted; by means of the special swivel attachment, the machine not only always finds its alignment for drilling, but the whole machine can be swung out of the line of the hole, so that the drill bit can be withdrawn without removing the drill from the wedge-pin.

The total weight of the machine is 50 lb., so that it can be readily set up and operated by one man. The best results are obtained with a pressure of 80 to 100 lb., but the machine can be operated with 50 to 55 lb.; the air consumption at the lower pressure being about 20 cubic feet of free air per minute.

The No. 8 Whitelaw machine, fitted with split nut (fig. 6), averaged 40 holes 4 ft. deep, 1¼ in. diameter (this depth being obtained by using three drills of varying length) in one shift, viz., from 6 a.m. to 2 p.m. the iron ore containing 35 per cent. of iron, and the complete pressure 50 to 60 lb.

The Whitelaw ore-boring drill, fitted with automatic withdrawal and refeed (shown in fig. 7), is one of the firm's standard Whitelaw reversible drills, fitted with a special attachment by means of which the screw bar cut with a very quick pitch, is driven by differential set of gears, which can be adapted to give any feed required from one-eighth of an inch per revolution, to any range which is desired. By means of the



Weight, 45 lb; diameter of Piston, 2½in.; length of stroke, 2½in.; air pressure required, 80 to 90 lb.; approximate consumption of free air per minute, 45 cubic feet; diameter of hole, 1½ in.; depth of hole, 4 ft.

FIG. 3.

IMPROVED COMBINATION HAND AND TRIPOD ROCK DRILL, LARGE SIZE.

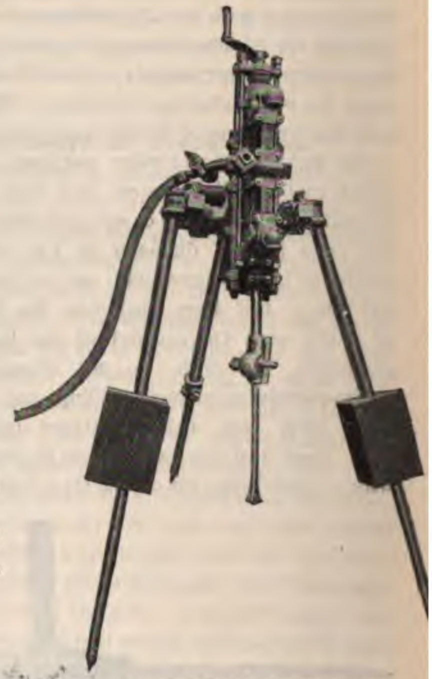


FIG. 4. TORPEDO ROCK DRILL.

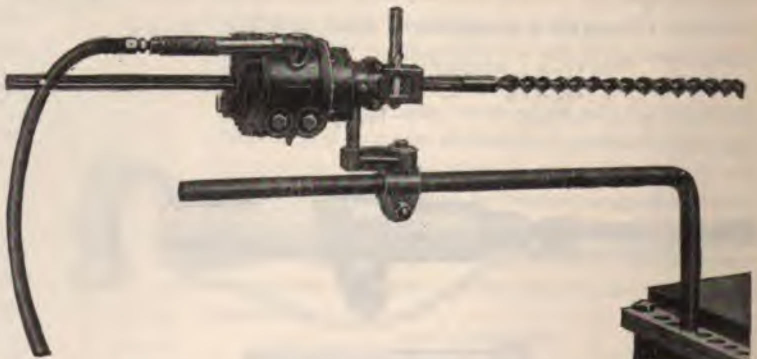


FIG. 5. LITTLE GIANT DRILL WITH SPLIT NUT.

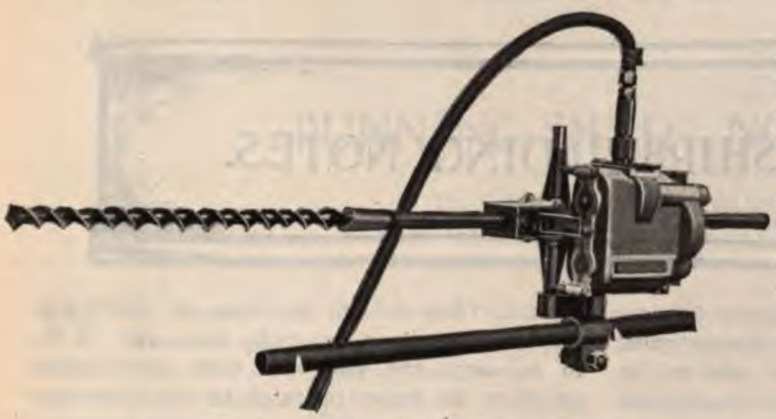


FIG. 6. WHITELAW DRILL WITH SPLIT NUT.

The weight of the machine complete is about 60 lb.; it will drill at the rate of 3 or 4 ft. per minute. The screw bar can be withdrawn from the hole in about 10 sec. by means of the operator manipulating a clutch-lever, which is provided at the side of the machine, the machine during all these operations running continuously in a forward motion.

special withdrawal and refeed mechanism the clutch will slip, in the event of the drill meeting an obstruction, and the drill will be automatically withdrawn, and refed after the drill has been retracted sufficiently to effect a clearance. This operation being quite automatic in its action, the resistance at which the clutch will slip can be easily regulated while the machine is running.

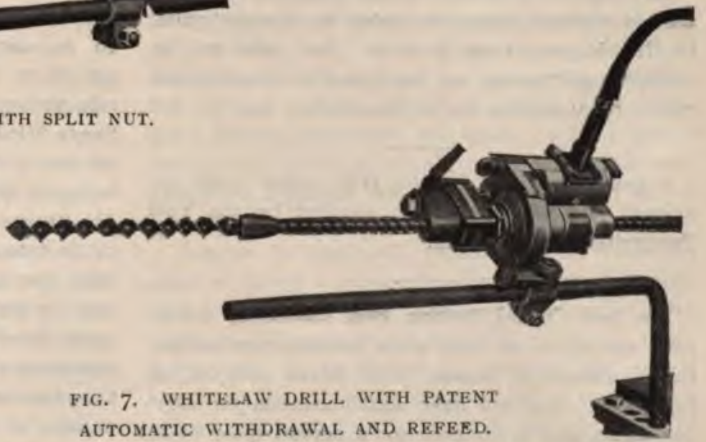


FIG. 7. WHITELAW DRILL WITH PATENT AUTOMATIC WITHDRAWAL AND REFEED.

OPENINGS FOR TRADE ABROAD.

Australia.

Tenders for the supply of the following railway materials will be received at the Supply and Tender Board Office, Adelaide, up to 5th April:—

348 bars of channel steel (two drawings, 1s. each); 54 bars of angle steel (one drawing, 1s.); 1,017 bars of angle steel (one drawing, 1s.); 11 bars of square root angle steel (two drawings, 1s. each); 12 bars of tee steel; 145 mild steel plates or bars; 540 mild steel plates; 1,470 mild steel plates, and 250 feet of iron chain.

Specifications may be seen in London at the office of the Agent-General for South Australia.

Orange River Colony.

A Board of Trade correspondent writing from Thabanchu remarks:—

"British manufacturers should look out for orders for pumping plants. The Government are realising every day the necessity for boring for water as much as possible, and the Land Settlement Department are offering drills at low hire to settlers, and have lately bought six new Juniper drills, which are being operated with as fast as possible. As in many or most instances the water when found does not run out, and cannot be furrowed out, it is necessary to use a deep well pump, with either steam, oil, wind, or horse-power."

Belgium.

Tenders are in demand until the 14th prox. for the construction of a railway between Lahamaide and Flobecq at the estimated cost of £9,000. A deposit of about £880 will be required to qualify any tender. Copy of the specification may be obtained from "M. le Directeur General, Societe Nationale des Chemins de Fer Vicinaux, 14 rue de la Science, Brussels."

Argentina.

The Government of the Province of Corrientes have submitted to the Provincial Legislature a scheme for the erection of a cotton ginning factory, and also a factory for the extraction of vegetable oils. Both factories, which are to be equipped with the latest appliances, are to be completed within two years from date of contract.

Ottoman Empire.

There will shortly be an opening here for railway plant, the Anatolia Railway Company having had surveys carried out with view to augmenting the line from Haïdar-pacha to Pendik.

SHIPBUILDING NOTES.

Five Clyde shipbuilders in the Admiralty list have sent in tenders, plans and models for the new yacht for His Majesty King Edward. The yacht will be smaller than the last one built, and it is understood that turbine engines are to be specified for.

A handsome typewriter for H.M. steam yacht the *Victoria and Albert* has been supplied by the Yost Typewriter Company, Ltd.

The new Cunard turbine liner *Carmania*, 678 ft. long, and of 21,000 tons gross tonnage, was successfully launched by Messrs. John Brown and Co., at Clydebank. She will have accommodation for 2,656 passengers, and is designed for a normal speed of 21 knots. Lord Inverclyde was present and the vessel was named by Lady Blythswood. The launch may be said to be the beginning of a new era in the transatlantic service, except as regards the machinery the *Carmania* is practically a replica of the *Caronia*, launched a fortnight ago. The latter vessel is fitted with quadruple expansion engines driving twin screws, while the *Carmania* will have triple screws driven by three separate Parsons' turbines. At the lunch which followed the launch, Mr. John Ellis remarked that the *Carmania* would afford an unique example of ascertaining the merits and demerits of turbine propulsion as compared with reciprocating engines. In the *Carmania's* turbines were one and a quarter million small brass blades.

The finely modelled steel screw steamer *Hillhouse*, built by the Northumberland Shipbuilding Company, Ltd., Howdon-on-Tyne, to the order of Messrs. John Cory and Sons, Ltd., Cardiff, for the Seville and United Kingdom Carrying Company, Ltd., left the Tyne for her trial trip, which proved in every way satisfactory, a speed of 11 knots being easily obtained. After the trial trip the s.s. *Hillhouse* sailed under the command of Captain Williams for Cardiff.

On Friday, the steamer *Netherton*, built by the Northumberland Shipbuilding Company, Ltd., Howdon-on-Tyne, to the order of Messrs. John Greenlees and Co., Glasgow, left the Tyne for her trials. She is 372 ft. long by 48 ft. beam and 30 ft. 10 in. deep, and has been built under special survey to the highest class at Lloyd's, spar deck rule with extra strengthening for special freeboard. She is fitted with long poop, long bridge, top gallant forecastle, the accommodation which is very ample being all placed in steel houses on the bridge deck. The 'tween decks are lofty and so arranged that cattle, troops, or emigrants may be carried if necessary. Very special attention has been paid to the loading and discharging gear, and a complete outfit for the rapid handling of cargoes has been arranged for consisting of eight steam winches by Messrs. Clarkes Chapman and Co. Ltd., Gateshead-on-Tyne, a large number of cargo derricks, steam steering gear by Messrs. Caldwell and Co., Glasgow, and steam windlass by Messrs. Emerson, Walker and Thompson, Bros. She is of course fitted with the usual water ballast arrangements for light passages. The vessel has been constructed to a fine model with a view to rapid speed and economy in fuel, and the machinery (consisting of engines with cylinders 24½ in., 40 in. and 68 in., by 48 in. stroke, three large boilers 13 ft. 9 in. by 11 ft., with 180 lb. working pressure), has been supplied by The North Eastern Marine Engineering Company, Ltd. The steamer will carry about 7,000 tons loaded. She is a duplicate of the three *Queen* steamers already built by this firm for Messrs. Thomas Dunlop and Sons, Glasgow. During construction the *Netherton* has been superintended on behalf of the owners by Mr. Broom and Mr. McIntosh.

The trial trip proved in every way satisfactory, and a mean speed of over 12 knots was easily obtained. Among the guests on board were the following: Messrs. John and Thomas Greenlees, Thomas Dunlop, A. H. Buchanan and T. M. Broom, Glasgow, Mr. Kightley, Newcastle, Mr. Rowland Hedge, and Mr. J. Graham, representing builders, Mr. D. Myles, representing engineers, and Messrs. Champn Finlay, Lloyd's surveyors. After t *Estherton* sailed under the command Simpson for the Bristol Channel.

RUNNING-SHED NOTES.

IV.—BY J. C. R. ADAMS.

WHEN the engine is supplied with automatic expansion gear, consisting, as is now most commonly the case, of a swinging link worked by the expansion eccentric, the radius-rod from the expansion-valve spindle is pivoted to a die capable of sliding in the curved slot of the link from top to bottom, and the point of cut-off is determined by the height of the die in the link as fixed by the position for the time being of the governor sleeve, to which it is connected by a lever and suspension-rod.

There is an apparent difficulty in connection with this arrangement, owing to the error in the piston's movement caused by the angularity of the connecting-rod, which may be worth clearing up. It is the practice in designing valve gears, as a rule, to assume the connecting-rod of infinite length, in other words, to consider the piston's movement in relation to the crank as alike at the two ends of the stroke. Let us first state the problem and then see how the valve gear I have mentioned can be adjusted to redress the inequality in the movement.

Taking a horizontal engine for example, and assuming uniform rotation of the flywheel, the two halves of the revolution (supposed to be divided by a vertical diameter of the crank-pin circle) are performed, of course, in equal times; but, owing to the action of the connecting-rod, which translates these equal divisions of the crank-circle into unequal fractions of the piston's stroke, the mean velocity of the piston is much greater while the crank is performing the half-revolution next to the cylinder than during the corresponding half furthest away from it. If the connecting-rod is, say five cranks long, the piston's velocity just before and after the beginning of the stroke at the end furthest from the axis of the crank shaft, is 50 per cent. greater than in the corresponding positions at the other end; these differences rapidly diminishing as the stroke proceeds, until at near mid-stroke they, of course, disappear.

Now, putting aside the automatic gear for a moment, suppose a single slide valve with an eccentric adjustable for different points of cut-off, but giving a constant lead. If we turn the engine round to each of the two dead centres in turn, and lengthen or shorten the eccentric-rod until the lead (or amount the steam-port is open at the dead centres) is the same at each end, we shall find that to secure an equal length of admission at both ends of the stroke, the eccentric-rod will have to be lengthened, so as to move the slide-valve further away from the crank; a little only if for an early point of cut-off, but a good deal, comparatively, speaking, for a late cut-off; and so *pro rata*, for all points in the stroke.

Now, in the automatic expansion gear, where the point of cut-off is constantly varying (that the variation is performed upon the second or outer valve makes no difference in the principle) we are, in effect, called upon to be continually altering the virtual length of the expansion eccentric-rod if we wish to secure symmetrical indicator-cards for all points of cut-off within the range of the gear. How is this rather difficult condition fulfilled in practice?

The engine is left by the erector with the link swinging through equal arcs on each side of a vertical line dropped through its centre of suspension; and if indicator diagrams are taken under these conditions, it will be found that though a pair of symmetrical diagrams can be got for any one point of cut-off, by adjusting the length of the valve-spindle or the radius-rod, yet they become unequal the moment the governor causes a change in the cut-off.

This can be corrected by increasing the length of the expansion eccentric-rod to an amount found by trial when taking the indicator cards. The effect of this adjustment is to cause the expansion link to swing or vibrate through a longer arc on the side nearest the cylinder (or, in other words, to incline the link a little towards the cylinder), with the result that as the radius-rod is raised by the governor, not only is the travel of the valve reduced giving an earlier cut-off, but the virtual length of rod is reduced also in corresponding degree, and *vice versa*. We are thus able to get symmetrical cards from the two ends of the cylinder at any and every point of cut-off.

Before leaving the governor, we must note that it is a *sine qua non* that the expansion valve be set to cut off at zero, when the governor sleeve is in its highest position, or accurate governing cannot be secured.

CORRESPONDENCE.

To the Editor of PAGE'S WEEKLY.

DESTRUCTORS AND ELECTRICITY.

DEAR SIR,—Owing partly to the publication of a very instructive paper, read by Mr. W. P. Adams, before the Institution of Electrical Engineers, public interest in the above question has been considerably stimulated. I think, therefore, that it may be not out of place to point out, with your kind permission, some misconceptions which may arise.

There is a tendency in some quarters to estimate the efficiency of any particular destructor by the number of electrical units per ton of refuse which are produced in the works where such destructor is in use.

The number of units which are produced per ton of refuse burnt depends chiefly on the following factors :—

1. The calorific value of the refuse.
2. The conditions as to day and night load, which determine whether all the refuse is used for steam raising, or whether the destructor is working at full power, while the electricity plant is practically idle.
3. The efficiency of the electrical generating plant, which may require more or less steam per unit generated.
4. The efficiency of the destructor plant, with its boilers and flues.
5. Last, but not least, the efficiency of the management.

It is, therefore, absurd to attribute to the destructor, either the whole credit for a good result in units per ton, or the whole blame for a poor result, and this is demonstrated by the fact that you will find one destructor of a given make giving a very high figure, and another destructor of the same make, but under different conditions, giving a low figure.

One of the most important factors in the efficiency of a destructor, the cost of labour, is usually ignored when dealing with steam raising results. In any destructor, increased steam raising results can usually be obtained by putting on increased labour, and "stoking in spoonfuls." From the steam raising point of view, the all important question is, what is the cost of a ton of steam produced by the destructor in ordinary everyday work ?

Under the heading "Steam from Refuse and its Cost," one of your contemporaries published last year some interesting figures, showing the cost of labour per ton of steam, as well as the evaporation per pound of refuse; at a number of combined stations. It was shown that those stations where the highest evaporative results are obtained are not always the most economical, owing to the large expenditure in labour, and it is noteworthy that among those stations where utilisation of steam is complete the best result came from Fulham.

If the destructor produces a supply of steam at a reasonable cost for labour, it is for the electrical department to utilise that steam, and the credit for good results and the blame for bad results belong by rights to the engineers who are responsible for the construction and management of the whole combined works, and not to the maker of any particular part of the installation. I think that if the above facts were more generally recognised, it would be in the interest alike of electrical engineers, destructor builders and the public.

I am, dear Sir, yours faithfully,

F. L. WATSON, A.M.Inst.C.E.

OBITUARY.

The late Mr. Gabriel James Morrison, M.Inst.C.E., was intimately associated for many years with the development of railways in China, having gone out to the East as engineer of the first railway laid down in Chinese territory. Subsequently, Mr. Morrison established himself in business at Shanghai as a civil engineer, and his firm of Morrison and Gratton, was associated with many important engineering works in Shanghai. After his return to England Mr. Morrison acted in conjunction with Sir John Wolfe Barry as consulting engineer to the Shanghai-Nanking railway. As a matter of historical interest, it may be mentioned that Mr. Morrison was present at the laying of the first Atlantic cable.

The death is recorded at the early age of thirty-eight of Mr. Frank T. Marshall, director of Messrs. R. and W. Hawthorn, Leslie, and Co., Ltd., who had charge of the marine engine works of that firm.

Mr. James Frederick Jackson, who died suddenly at Torquay, was a member of the firm of Messrs. Spear and Jackson, steel manufacturers, Etna Works. Sheffield, and son of the late Alderman J. B. Jackson, who had been mayor and master cutler of Sheffield.

INSTITUTION OF MECHANICAL ENGINEERS.

MR. EDWARD P. MARTIN ELECTED PRESIDENT.

THE annual general meeting was held on Friday last in the hall of the Institution, Storey's Gate, S.W., Mr. J. Hartley Wicksteed presiding.

The Chairman moved the adoption of the report, extracts from which appeared in the last issue of PAGE'S WEEKLY. He said he would like to emphasise one paragraph of the report, which has been read by the Secretary, with regard to the letters used to indicate membership of the Institution. It was suggested that instead of using the letter M, members, associate members and others should use the word Mech., so that the proper description of a member would be M.I.Mech.E. Members might be quite certain that this suggestion was not made without good reason, and it was hoped that the recommendation of the Council would be followed.

Mr. Edward P. Martin seconded the resolution for the adoption of the report, which was unanimously carried.

The Secretary (Mr. Edgar Worthington) announced that, as a result of the ballot, Mr. Edward P. Martin had been elected President for the ensuing year, Mr. Arthur Keen and Sir William T. Lewis, Bart., as Vice-Presidents, and the following members as Council: George J. Churchward, Henry Davey. William Dean, H. Graham Harris, The Right Hon. W. J. Pirrie, LL.D., Sir Thomas Richardson, Mark H. Robinson.

Mr. J. Hartley Wicksteed: It is now my duty to vacate this chair, and, in doing so, I have the greatest pleasure in inviting Mr. Martin to be my successor. Mr. Martin is a man who has been salted; he has already been President of the Iron and Steel Institute; he is a man of large experience, and great travel, being acquainted with nearly every quarter of the globe, where mechancial engineering is practised, and he has been, I may say, in pickle by the Council for this position for several years. Up to the present time, however, his energies have been entirely absorbed in enormous responsibilities in connection with mechanical engineering and iron and steel making, but now that he is getting easier in respect of his obligations in industrial affairs, he is able to devote some of his boundless energy to the good work of conducting and guiding the prosperity of this Institution. I could have vacated the chair in favour of no one with greater pleasure than I do in favour of Mr. Martin.

Mr. Edward P. Martin then took the chair as President.

VOTE OF THANKS TO THE RETIRING PRESIDENT.

Dr. Kennedy: Mr. President and gentlemen,—While congratulating ourselves on our new President, and our new President on his election, it is at the same time my pleasureable duty to move a resolution of thanks to the retiring President, Mr. J. Hartley Wicksteed, for the excellent manner in which he has filled the office of President during the past two years. That motion does not require that I should make any long speech; you yourselves have seen Mr. Wicksteed frequently during his period of office, and you know what he has done. I was looking at the chart which is hanging on the wall of this hall, dealing with the growth of membership of this Institution, and I studied with particular interest the figures for the years 1894 and 1895, when I had the honour of being your President, and I cannot help noting, although I thought we worked very hard in those days, that the great increase of membership has taken place since that time, and it is plain to me that, though I found the duties of President for two years somewhat laborious, Mr. Wicksteed, with this increasing membership, found these duties much more severe and arduous than they were when I had the honour of occupying the chair. In addition to carrying out the duties of President of the Institution at home, there fell upon Mr. Wicksteed this year the duty of representing the Institution in America during our official visit. This was no light task, gentlemen, but Mr. Wicksteed fulfilled it in a manner which merits our heartiest thanks, while I am pleased to say that, in representing the Institution, Mr. Wicksteed made himself extremely popular on the other side. Another fact to which I should like to direct attention is that in Mr. Wicksteed we returned to something more like the typical mechanical engineering President of the old days of this Institution. I am very glad that Mr. Wicksteed has occupied the chair of this Institution and filled it, as I have said, with so much ability and credit to himself and to us. I move a cordial vote of thanks be accorded to Mr. Wicksteed for the way in which he has performed his duties as President of this Institution.

Mr. Maw seconded, and the new President (Mr. Martin) supported the resolution, which was carried with acclamation.

Mr. Wicksteed: I thank you very heartily for this expression of good will and appreciation and for the kind remarks made by Dr. Kennedy, Mr. Maw, and the President, and I am very pleased to hear that my friends in America think so well of me. I know that I formed a very cordial relationship with the President of the American Society, and many others whom I met on the other side, and I am happy to think that I proved a worthy representative of this great Institution. The President has touched upon a thing on which I have, perhaps, prided myself more than anything else, and that is the character of the meetings and discussion which have taken place in this hall, under my presidency. I have on many occasions seen this hall so full when our papers have been read and discussed as to cause misgivings as to whether in a short time it would not be too small, and I think I may say that during my term of office the interest in the papers and discussions has never flagged. Reference has been, made to the arduous character of the duties performed but I must say, and it will be an encouragement, I hope, to my successor, that I have not found it in the least degree a strain, but a pleasant relaxation. I have, during my long career, been subjected to eight contested elections, and it is by a process of survival and longevity, that I have lived to fill the office of President. My position, however, is now fairly secure, as I belong in future to the House of Peers, and shall in future be subjected to no interference in the shape of contested elections. I have to thank the members of the Council for the assistance they have rendered me during my term of office, and you, gentlemen, for the kind way in which you have received this resolution.

TRAMWAYS PERMANENT WAY CONSTRUCTION AND MAINTENANCE.

A paper on this subject was read before the Leeds Local Section of the Institution of Electrical Engineers on the 16th inst. The following is a brief abstract. The author expresses a preference for girder rails weighing 96 lb. per yard, with fish plates 25 in. long weighing 70 lb. per pair, and anchored down at the joints with Howard Cooper's patent joint, 24 in. long, with six rivets into the bottom flange of each rail. He has also used an intermediate anchor, either one similar to those at the joints, or the Ames Crosta Bull Dog Anchor block. The author gives it as his strong opinion that it is better to lay the metals first and the concrete afterwards. The metals should be placed on wooden blocks packed up with wedges to the exact level, at intervals of about 9 ft. apart, then the line crowed, afterwards the concrete is packed under the metals and the remainder of the track to the level of the bottom flange of the rail. After this has stood for two days the wooden blocks are taken out, and the holes filled in with concrete, and the following day the whole of the crevices under the metals are run in with a mixture of sand and cement (1 to 1).

The author has used rails 60 ft., 45 ft., and a few 35 ft. long, but prefers the 45 ft. lengths as being more readily handled, while there is not the danger of sagging which occurs with a longer rail. Moreover, the 45 ft. rail only requires one intermediate anchor, whereas the 60 ft. rail ought to have two to each rail.

The fishplates should be rolled from the same quality of steel in all respects as that specified for the rails. They shall be capable of being bent, when cold, round a bar 4 in. in diameter, without fracture.

THERMIT WELDING PROCESS.

The engineer must be very careful in the gauging of the rails or it is a great strain on the wheels of the cars. The gauge on curves should be slightly less, varied according to the sharpness of the curve. The author has used both manganese and crucible cast steel points and crossings, and thinks the former has a longer life. When occasion arose for relaying the track at Halifax, the author had the whole of the joints welded on the Thermit process.

He had some tests made of the electrical resistance of Thermit welding and otherwise, with the following results: Taking a solid rail 8 ft. long as a standard resistance, ·000068 ohms; with Thermit welded joint, without bonds, same length, ·000072 ohms; with Thermit welded joint, with one bond, same length, ·000067 ohms; fishplates, sole-plate, and two bonds, newly constructed, ·000078 ohms; fishplates, sole-plate, and two bonds, after two years, ·000095 ohms.

The welded joint has a considerable value mechanically by giving increased strength to the track..

Reference is made by the author to the need for every engineer having under his control the construction and maintenance of permanent way, possessing an emery rail grinder. The one in use at Halifax is, up to the present unique, it being the only one of its kind so complete. It was built by Messrs. Ames, Crosta and Co., Nottingham, specially for Halifax, and is fitted up with an electric motor, so that it can travel and work from the overhead wire. It is also fitted with a twelve h.p. petrol motor, and can travel and grind from this, if the overhead equipment is cut off, or in case of construction where the equipment has not been completed. The machine is fitted up with a complete set of drilling apparatus for drilling longtidudinally and vertically, or, if requ [illegible] angle, which is very useful and i [illegible] either motor.

MICROSTRUCTURE OF CAST IRON.

At the last meeting of the Iron and Steel Institute Mr. O. F. Hudson read a paper on this subject. The following is an abstract of a portion of the paper, dealing with the manner in which specimens are prepared :—

The specimens for micro-examination are taken when possible by sawing a small piece from the metal to be examined. In the case of mottled and white iron such a course is not possible, and the specimen has to be taken by chippings. The specimen may conveniently be of the following dimensions : $\frac{1}{2}$ in. × $\frac{3}{8}$ in. × $\frac{3}{16}$ in. One of the large surfaces is then made perfectly plain by filing with a smooth file, and the edges bevelled to prevent tearing of the polishing papers. A smooth-filed, clear, perfectly plain surface having thus been obtained the file marks are removed on fairly coarse emery paper, and the polishing continued on emery papers of increasing degrees of fineness. The final polishing and removal of all scratches is done on chamois leather, moistened with a thin paste of the finest rouge, or better still with alumina obtained by the calcination of ammonium alum. Alumina is much more effective as a final polisher than rouge, and for cast-iron work is very easily prepared. It is usually recommended for general purposes that the alumina should be ground and graded by careful levigation, and the products made into pastes with the finest Castile soap. A polishing powder that answers admirably for the final polishing of cast-iron may be made by calcining ammonium alum in a porcelain dish in a muffle and lightly grinding the alumina so obtained, the powder being dusted unto moistened chamois leather for polishing.

An examination of the specimen after final polishing, and before etching often gives useful information, *e.g.*, the amounts and relative distribution of graphite and phosphide eutectic in grey phosphoric irons. In etching specimens of cast-iron there is a fairly wide choice of reagents that give satisfactory results, but perhaps the most convenient are either

(*a*) a 2 per cent. solution of nitric acid in water or alcohol, or

(*b*) a 5 per cent. solution of picric acid in alcohol.

To avoid misleading results etching should be conducted with discretion, and the specimen should be examined under high and low powers, the etching being, if necessary, continued further, or the specimen repolished and re-etched. After etching the specimen may, with advantage, be rubbed lightly on parchment covered with a thin paste of precipitated calcium sulphate.

INSTITUTION OF CIVIL ENGINEERS.

The annual dinner of the Yorkshire Students' Association of the Institution of Civil Engineers was held at the Queen's Hotel, Leeds. Mr. Ewing Matheson, M.Inst.C.E., presided, and among those present were the Lord Mayor of Leeds (Mr. N. Armitage), Sir Alex. N. Binnie (Vice-President, Institute of Civil Engineers), and Dr. Tudsbery (Secretary, Institute Civil Engineers). Sir Alex. Binnie replied to the toast of the "Institution of Civil Engineers," and Dr. Tudsbery proposed the "Association of Yorkshire Students," which was suitably acknowledged by Mr. Matheson.

LEEDS UNIVERSITY ENGINEERING SOCIETY.

At a recent meeting of this society, Dr. J. T. Nicolson read a paper on "High-speed Tool Steel and the Lathes for its use." He explained that he did not intend to deal so much with high-speed cutting steel as with the forces exercised during the operation of cutting. He alluded to the discovery that tool steel may advantageously be heated up to 2,000 degrees F., if properly cooled afterwards. He analysed the form of a chip cut at dead-slow speed and showed what happens precisely at the point of the tool. Experiment and observation show that 70 degrees is the most effective degree of sharpness, and that to work at high speed, within certain limits, is conducive to the life of a tool. At slow speeds it is the point of the tool which does the work, but at higher speeds the point is kept cool, and the work is done behind the tool point. The lecturer described the dynamometer used in measuring the forces exercised in all directions during cutting. It has been found that stress is constant whatever the area cut ; that the forces required to sustain the tool when taking a cut are proportional to the area of the point of the tool, quite apart from the form of the cut, and that the force does not depend on the speed of cutting.

At a recent meeting of the Dundee Institute of Engineers there was an interesting discussion on the problem whether it would be more economical for Dundee mills to take power from a central electric station, or to drive by their own engines. Figures were submitted showing the relative costs of driving local mills by steam and electricity, and in the cases quoted there was shown a considerable economy to be gained by steam driving. Mr. Henry Richardson, the City electrical engineer, opened the discussion.

TECHNICAL SOCIETY NOTES.

The American visit of the Institution of Mechanical Engineers was again the subject of discussion at the last meeting, and the comparisons made, while admitting the high place taken by American engineers in the domain of mechanical engineering, certainly brought out nothing which puts Great Britain in the second place. As Mr. Thompson suggested, differences in design are not necessarily improvements, and he expressed himself unable to understand why American engineers had reversed the continental practice in pump engine construction with regard to the placing of Corliss and poppet valves. The only explanation which Mr. Barr, author of the paper on "American Pumping Machinery" could offer was the necessity for large ports and small clearances.

With regard to the duties obtained from pumping engines, Mr. Thompson who spoke from long practical experience, said it was the fashion to assume that American duties were much better than those obtained on this side, but in making that assumption, the difference in the sizes of pumping engines constructed in America, and in this country, was not taken into consideration. It was pointed out that while American engines ran up to 1,000 h.p., the engines in use here were not often more than a third of the size, and taking that fact into consideration, the duty obtained from English-made engines compared very favourably with those of American construction. Mr. Simpson, who spoke later on the same subject, was of a similar opinion. It is all a matter of opportunity, and if British waterworks companies and other corporate bodies would give English engineers a chance of building an engine of 1,000 h.p., the results obtained would be as good as those referred to in Mr. Barr's paper. And Mr. Barr himself, catching the infection, said that given equal chances, English engineers would surpass their American cousins.

Mr. Hartley Wicksteed told an interesting story of his visit to the McGill University at Montreal, which bears upon the same question of British and American engineers, and as to whom belongs the pride of place. It appears that visitors to the University find as part of the equipment of the mechanical laboratory an elaborate experimental engine, with so many cylinders and cranks and designed for so many varied purposes that even Mr. Hartley Wicksteed, with all his experience, failed to keep count. The point of the narrative is that this engine to which the attention of visitors is directed with no little pride of possession, was designed ten years ago by Mr. Druitt Halpin, the well-known English engineer, and still holds its own with anything which America can produce. Mr. Halpin was there in person to modestly confirm the truth of Mr. Wicksteed's narrative.

Mr. Alfred Saxon, author of the paper on "Engines at the Power Stations and at the St. Louis Exhibition," gave the meeting some instructive figures with the aid of diagrams. Some surprise had been expressed at the figures quoted by Mr. Saxon in his paper, but good as were the results given as achieved by American engines, Mr. Saxon was able to show that British engineers can better them. At the present moment there are being built in Lancashire for the London County Council four sets of engines rated at 5,000 i.h.p., working under normal load, and capable like the American engines described in Mr. Saxon's paper, of working under 50 per cent. overload, and the duty which the English-built engines are expected to perform will be 12½ per cent. in excess of the American engines referred to. English engineering having thus been vindicated all round, the new President, Mr. Martin, very opportunely closed the meeting.

Professor Lilly's paper on "The Strength of Columns," which figured in the agenda, had to be held over until a subsequent occasion. The next meeting of the Institution will be an important one, as the report of the Steam Engine Committee is to be presented.

A paper on "Brakes" was to have been read a the last meeting of the Tramways and Light Railways Association, but a paper by Mr. Herbert Jones, on the working results of the Waterloo and City Railway took its place.

The new paper on the agenda at the Institution of Electrical Engineers' meeting yesterday was "Setting Type by Telegraph." This paper, and the discussion on Mr. Addenbrooke's paper, "The Value of Overhead Mains," will be dealt with in the next issue of PAGE'S WEEKLY.

Abstracts of the papers read at the Institution of Civil Engineers on the 14th inst. are now available. Mr. E. F. C. Trench, M.A., contributed a paper on the "Alfreton Second Tunnel," and Mr. D. McLellan's contribution to the Transactions was on "The Reconstruction of the Moncreiffe Tunnel." The Alfreton tunnel is, of course, on the Midland, and the Moncreiffe is the well known Caledonian tunnel near Perth.

At the Society of Arts on Monday last, Mr. Dugald Clerk delivered the second of the Cantor lectures on the "Internal Combustion Engine."

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts.

CONTRACTS OPEN.

	Last Day.
Copenhagen.—Supply and erection of a gasometer of a capacity of 200,000 cubic feet per hour for the Lighting Department of the Corporation. Valby Gasworks, Valby, Copenhagen	Feb. 27
King's Lynn.—Supply and erection of one 200-kw. steam dynamo, condenser, steam and other pipes for the Corporation. Mr. John Pilling, M.I.E.E., Electricity Works, King's Lynn.	Feb. 28
Hull.—Supply of mains and cables for 12 months, for the Electric Lighting Committee. City Treasurer, Town Hall, Hull.	Mar. 1
Barcelona.—The "Gaceta de Madrid" of January 18th contains a notice calling for tenders for the supply and installation in the sheds of the Barceloneta wharf of two transhipment cars for platform cranes. Conditions of contract and plans may be inspected at the offices of the Secretary of the Port Administration, Casa Lonja, Barcelona	March 1
Glemsford (Suffolk).—Six contracts in connection with water supply. Particulars of the Engineer, Mr. J. T. Eayrs, Clarence Chambers, Corporation Street, Birmingham	Mar. 1
Wimbledon.—Supply of stores to the Electricity Department for one year from April 1. Electrical Engineer, Durnsford Road, Wimbledon	March 4
Johannesburg.—Supply of 100 electric cars, two electric water-cars, five-ton crane, car traverser, and workshop tools for Municipal Council	March 6
Manchester.—Laying underground telephone pipes (Contract No. 11), with other appurtenant works for the Paving, Sewering, and Highways Committee. City Surveyor's Office, Town Hall, Manchester	Mar. 6
Stoke Newington.—Supply, délivery and erection of sub-station plant and mains. Four-section contract. Mr. W. F. Loveday, Borough Surveyor, Town Hall, Milton Road, Stoke Newington, S.E.	March 8
Broadstairs.—Construction, delivery, and erection at the above station of a horizontal tandem compound engine, condenser, well pumps, and all accessories. Mr. Percy Griffith, M. Inst. C.E., 54, Parliament Street, S.W.	Mar. 11
Brighouse.—Widening of the Calder Bridge, Brighouse, by means of steel lattice girders and steel stanchions for the Corporation. Mr. S. S. Haywood, Borough Engineer, Municipal Offices, Brighouse ...	Mar. 11
Belgium.—The "Bulletin Commercial" announces that the Belgian State Railways invite tenders for the installation of two sets of ventilating and heating apparatus in the central workshops at Mechlin. Particulars of M. Slaghmuylder, Engineer-in-chief, Station du Nord, Brussels ...	March 6 March 13
Park Royal—Supply, delivery, and erection of plant in connection with the electricity generating station at Park Royal and proposed sub-stations and distributing centres at various places, for the Great Western Railway Company. Messrs Kennedy and Jenkin, 17, Victoria Street, S.W.	March 13
South Shields.—Supply, delivery and erection of the following plant in connection with the electricity supply department:—One multitubular marine type boiler, two medium-speed open-type vertical engines for two 550 k w. direct current traction generators, two 500 k.w. direct current generators and traction switchboard. Mr. J. H. Cawthra, Borough Electrical Engineer	March 13
Axbridge (Somerset).—Supply of about 600 tons of cast-iron socket water-pipes 7-in. to 4-in in diameter, for Axbridge Union Rural District Council	Mar. 13
Llandyfodwg and Llantrisant (Wales). The Ogmore and Garw Urban District Council invite tenders for two distinct and separate schemes of bridging the valley at Gilfach, by extending Coronation-road, Evanstown, in the parish of Llandyfodwg, to join the highway known as Gilfach-road, in the parish of Llantrisant Mr. H. Dawkins Williams, Surveyor, Bryn, Menin	Mar. 14
London.—Supply of electrical stores for year ending March 31, 1906, for the Fulham Borough Council. Town Clerk, Town Hall, Fulham...	Mar. 15
Shanghai.—The Shanghai Municipal Council invite tenders for the construction and operation of about 24 miles of electric tramways on the trolley system in the streets of the Settlement of Shanghai; alternative proposals are desired for the single-trolley and double-trolley lines. Council's agents, Messrs. John Pook and Co., 63, Leadenhall Street, London, E.C., and Messrs. Fearon Daniel and Co., 90, Wall Street, New York.	March 31
Newport (Mon.).—Construction of main outfall and branch sewers for the Western Valleys Sewerage Board. Particulars at offices of Mr. Baldwin-Latham, Parliament Mansions, Victoria Street, S.W.; Mr. Geo. Chatterton, 6, The Sanctuary, Westminster, S.W.; or Mr. T. S. Edwards, Clerk to the Board, Newport (Mon.) ...	April 8.

COMING CONTRACTS.

Aston.—The Town Council has adopted a scheme for reconstructing and converting the remaining tram ways in the borough at a cost of £63,270.

Devonport.—The Local Government Board has sanctioned the borrowing by the Corporation of £7,958 for extending the electric supply plant.

Sunderland.—The Corporation has decided to apply for sanction to borrow £15,000 for electric supply purposes.

Swinton and Pendlebury.—Application is being made by the District Council for sanction to borrow £6,900 for electric supply purposes.

West Hartlepool.—The Local Government Board has sanctioned the borrowing by the Town Council of £13,310 for electric supply purposes.

Switzerland.—Projects for three electric tramway routes have recently been approved for Berne, and an electric railway from Aigle to Sepey, Leysin and Feydey is to be constructed. For this latter project particulars can be obtained from the Aigle-Ollom Monthey Railway Company, Aigle, Switzerland.

Guatemala.—The tramway lines are to be converted to electric traction. Further information can be obtained from Mr. Richard Echeverria, Guatemala City.

Egypt.—Amongst the estimates for 1905 are: irrigation works, £953,000; bridges, £100,000; harbour works at Alexandria, £158,000; harbour and railway works at New Suakim, £150,000.

Copenhagen.—A scheme for doubling two railway lines and for constructing a high-level bridge over the Little Belt is under consideration. The estimate is about £4,000,000.

Chelsea.—The Council's application for sanction to borrow £29,000 has been before the Local Government Board.

Cupar.—The Town Council have under consideration a drainage scheme estimated to cost £10,000.

CONTRACTS CLOSED.

Islington.—The Borough Council have placed an order for seven 30-k.w. single-phase transformers with Messrs. Farranti, Ltd.

Little Halton, Bolton.—Orders have been recently received by Edward Dennis and Co., Ltd., from the Corporations of Birmingham, Burton-on-Trent, Coventry, Dewsbury and Middlesbrough. Orders have also been received from the Metropolitan Electric Supply Company, and the Stirling Boiler Company.

Buncrana, Ireland.—James Gordon and Co. have secured the contract for the supply, delivery, and erection of the complete hydraulic and gas power plant for the electric light station at Buncrana, Ireland.

Dublin.—Messrs. Davis-Perrett, Ltd., have received an order from the Dublin United Tramways Company for one of their electrical grease separating plants, capable of purifying 4,000 gallons of greasy water per hour, and have just installed a plant at the South London Electric Supply Corporation's works at Loughborough Junction to deal with 8,000 gallons of greasy water per hour.

War Office.—The Brightside Foundry and Engineering Company, Ltd., Sheffield, have received the order for heating the new War Office buildings in Whitehall. The system to be adopted is low-pressure steam heating, with radiators.

London.—The Paterson Engineering Company, Ltd., London, have recently received orders for Paterson feed-water purifiers from the following firms: Babcock and Wilcox, Ltd., Belliss and Marcom, Ltd., Danks and Co., the Electric Construction Company (2), the Mirrless Watson Company, Crompton and Co., and the Earl of Rosslyn's Collieries Company, Ltd.

Japan.—The Japanese Government have placed a contract with the North British Locomotive Combine, Glasgow, for fifty powerful locomotives. These are in addition to an order for a score of engines at present building for Japan.

London.—The Brush Electrical Engineering Company have received orders from the Middleton Electric Traction Company, J. J. White and Co., of Belfast, Keighley Corporation, Rochdale Corporation, and Erith District Council. The Erith order is for an overhead electric equipment, the other orders are for carbodies with Brush equipments.

Zurich.—The Horsfall Destructor Company, Ltd., of Leeds, have supplied a destructor installation to the town of Zurich, Switzerland; this installation comprises twelve cells, in which 120 tons of refuse can be burnt daily as it is collected, and without any addition of fuel.

APPOINTMENTS VACANT.

	Last Day.
Great Western Railway.—Electrical Engineer for traction and lighting. Salary, £600 per annum. The Secretary, Paddington Station, London, W.... ...	Feb. 27
Northampton.—Engineering Assistant under Corporation. Salary £100. Particulars of Borough Engineer	Feb. 28
Leeds.—The City Council have decided on the appointment of a waterworks engineer, at a salary of £1,000; Mr. Robert Fox, Town Clerk	Feb. 28
Chiswick.—Engineering Assistants under Urban District Council. Particulars of Mr. Ernest F. Collins, Town Clerk, Chiswick	March 2
London.—Assistant at the City and Guilds Central Technical College, to teach mechanical drawing and mechanism. Salary £150 per annum. Prof. Dalby, at College, Exhibition Road, S.W.	—

APPOINTMENTS FILLED.

Bradford.—Mr. Charles W. Salt, of Croydon, has been appointed assistant electrical engineer to the Bradford Corporation, at a salary of £250 a year.

Leith.—Mr. W. Relph, of the Stalybridge, Hyde, Mossley and Dukinfield tramways, has been appointed tramway superintendent to the Leith Corporation tramways.

Southampton.—Mr. Street, borough electrical engineer of Southampton, has been recommended for appointment, for a period of twelve months, as manager of the electric tramways of that town. Mr. Street would continue to discharge his present duties while holding the appointment in question. The total salary would be £650 a year.

Manchester.—Mr. S. L. Pearce has been appointed chief electrical engineer at the Manchester electricity works. The appointment is for a period of three years, and the salary is one of £900 for the first year and £1,000 a year for the remainder of the term.

Melbourne.—Mr. E. W. Skeats has been appointed professor of geology at the Melbourne University.

Johannesburg.—Mr. G. H. Stanley, the demonstrator in metallurgy and surveying at the Armstrong College, Newcastle-upon-tyne, has recently received a very important appointment in South Africa, having been elected to the professorship of metallurgy in the Technical Institute, Johannesburg.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

The following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares business is being currently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our Share List will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from possible inaccuracies.

STOCK EXCHANGE SETTLING DAYS.—Settling days on the Stock Exchange are as follows :—
Consols : March 1st. General Settlements : February 24th, March 15th, 30th. Bank Rate, April 21st, 1904, 3 per cent.

I.—ENGINEERING, IRON, AND STEEL COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
11,370	5	5%	Alldays & Onions Pneumatic Engineering, Ltd.	3	2½— 3
10,000	5	3/-	Do. Cum. Pref. 6 per cent. ..	5	4½— 5
3,210,000	1	2/6	Armstrong (Sir W. G.), Whitworth and Co., Ltd.	1	3 3/16 – 3 5/16
76,970	5	2/-	Do. 4% Cum. Pref.. ..	5	5⅜— 5⅝
1,500,000	100	4%	Do. 4% 1st Mort. Dbs. Rd.	100	103 —105
£100,000	100	4½%	Aveling and Porter, Ltd., 4½% Reg. Mt. Debs. Red.	100	96 — 99
530,000	1	1/7½	Babcock and Wilcox, Ltd., Ord. ..	1	4⅜— 4⅝
100,000	1	7½d.	Do. ,, 6% Cum. Pref.	1	1½— 1⅝
20,000	5	3/-	Baker (Joseph) and Sons, Ltd., 6% Cum. Pref.	5	5 — 5½
250,000	1	6⅝d.	Baldwins, Ltd., 5½% Cum. Pref. ..	1	1 — 1⅛
£250,000	Stk	4½%	Do. 1st Mt. 4½% Deb. Stk. Red.	100	101 —103
150,000	4½	2/8⅝	Barrow Hæmatite Steel Co., Ld., O.	4½	1 9/16 – 1 11/16
50,000	4½	6/-	Do. do. Cum 2nd. Pref.	4½	4½— 4¾
33,334	5	2/6	Bayliss, Jones and Bayliss, Ltd., 5% Cum. Pref. Shares	5	4¾— 5¼
£500,000	100	—	Beardmore (Wm.) & Co., Ltd., 4½% 1st Mt. Debs., Red., Scrip 50% pd	—	101 —103
50,000	10	6/-	Bell Brothers, Ltd., 6% Cum. Pref.	10	11¾— 12¼
£366,600	Stk	4%	Do 4% Deb. Stock, Red.	100	99 —101
200,000	1	1/-	Beyer, Peacock and Co., Ltd., Ord.	1	11/16 — ¾
300,000	1	6⅝d.	Do. 5½% Cum Pref.	1	27/32 — 29/32
£300,000	Stk	4½%	Do. 4½% Red. Deb. Stock	100	94 — 97
1,629,760	1	6d.	Bolckow, Vaughan and Co., Ltd., O. Nos. 1-1,629,760	1	1 — 1 1/16
1,860,900	1	3⅜d.	Do. Nos. 1,639,101-3,500,000	12/-	17/32— 19/32
1,160,000	1	4½d.	Brown (John) and Co., Lim., Ord., Nos. 1-1,160,000	15/-	1¼— 1⅜
590,000	1	6d.	Do. Ord., Nos. 1,160,001-1,750,000	1	1 25/32— 1 27/32
74,000	10	5/-	Do. 5% Cum. Pref.	10	11¼— 11¾
154,500	5	2/6	Cammell, Laird & Co., Ltd., Ord. ..	5	8¼— 8¾
232,500	5	2/6	Do. 5% Cum. Pref. ..	5	5¼— 5½
450,000	1	1/6	Clayton & Shuttleworth, Ltd., Ord.	1	31/32— 1 1/32
70,000	5	2/6	Do. 5% Cum. Pref.	5	5⅜— 5⅝
£250,000	Stk	4%	Do. 4% 1st Mort. Db. Stk. Red	100	100 —102
100,000	10	7/6	Consett Iron Co., Ltd., Ord.. ..	7½	31½— 32½*
57 031	10	10/-	Crossley, Bros., Ld, Ord. 40340/97370	10	16¼—16¾
40,339	10	5%	Do. 5% Cum. Pref.	10	11½—11¾
75,000	1	2/6	Delta Metal, Ltd. Shares	1	2⅛— 2¼
1,259,594	1	3⅜d.	Dorman, Long & Co., Ltd.	1	21/32— 23/32
£400,000	Stk	4%	Do. 4% 1st Mort. Perp. Deb. Stk.	100	91 — 94
200,000	5	3/-	Dunderland Iron Ore Co., Ltd., 6% Cum. Pref. and Participating..	5	3½— 3⅝
250,000	1	9⅜d.	Dunlop (James) & Co., Ltd., Ord...	1	⅝— ¾
300,000	1	7½d	Do. 6% Cum. Pref. ..	1	15/16 – 1 1/16
4,721	13	12/-	Ebbw Vale Steel, Iron & Coal Co., Ltd.	13	9 — 10
69,754	13	12/-	Do. do. do.	10	7⅝— 7⅞
20,250	10	8/-	Elliott's Metal, Ltd.	8	4⅞— 5⅛
5,000	10	5%	Do. Cum. Pref. 5%	10	8¾— 9¼
186,748	Stk	4%	Do. Deb. 4%	100	94½ – 96½
25,000	10	6/-	Fairfield Shipbuilding & Engng. Co., Ltd., 6% Cum. Pref. ..	10	10½— 11
£250,000	Stk	4½%	Do. 4½% Mort. Deb. Stk. Red.	100	97 —100
9,000	10	10%	Fleming & Ferguson, Ltd. Ord. Nos. 1/9000..	10	12¾—13¼
6,000	10	5%	Do. 5% Cum. Pref. Nos. 9001/15000	10	9½—10
126,000	3	3/-	Fraser & Chalmers, Ltd., Ord. ..	3	4⅝— 4⅞
21,000	3	1/6	Do. 7½% Cum. Pref.	3	5¾— 6¼
10,000	10	5%	Galloways, Ltd., 5% Cum. Pref. 18001/28000	10	6 — 7
£150,000	Stk	4%	Do. 4% 1st Mort. Deb Red..	100	90½—91½
16,800	10	—	Greenwood & Batley, Ltd., Ord. ..	10	4 — 4½
9,600	10	7%	Do. 7% Cum. Pref.	10	10¼— 10¾
965,000	1	10%	Guest, Keen & Nettlefolds, Ltd. Ord.	1	2 5/16— 2 7/16
344,000	5	2/6	Do. 5% Cum. Pref.	5	5⅞— 6⅛
£1,850,500	Stk	4%	Do. 4% Irred. Mort. Deb. Stk	100	105 —107
13,000	5	2/6	Gwynnes, Ltd., 5% Cum. Pref. ..	5	2 — 3
250,000	1	1/-	Hadfield's Steel F'dry Co., Ld., Ord.	1	3 5/16— 3 7/16
20,000	10	4/6	Do. 4½% Cum. Pref.	10	10¾— 11¼
30,000	5	3/-	Hall (J. & E.), Ltd. 6% Cum. Pref...	5	5 — 5½
408,505	1	1/6	Harvey United Steel Co., Ltd. ..	1	1 5/16— 1 7/16
47,500	10	7½%	Hawthorn, Leslie & Co., Ltd. Ord.	10	11 —11½
28,001	5	7/-	Head, Wrightson & Co., Ltd. ..	5	4¾— 5¼
85,000	1	7½d.	Hill (Richard) & Co. (1899) Ld., Ord.	1	⅝— ¾
18,000	5	3/-	Do. 6% Cum. Pref.	5	4⅝— 4⅞*
30,000	10	6/-	Hornsby (Richard) & Sons, Ld., Ord.	8	5½— 6

ENGINEERING, IRON, AND STEEL COMPANIES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices
750,000	1	6d.	Howard & Bullough, Ltd., Ord. ..	1	1 11/16—1 13/16
25,000	10	6/-	Do. 6% Pref. (Non-Cum.) ..	10	12¼— 12¾
£250,000	Stk	4%	Do. 4% Deb. Stk., Red. after 1905	100	98 —101
37,500	10	20	Kynoch, Ltd.	10	18¾— 19¼
49,537	10	5%	Do. Cum. Pref. 5%	10	10½— 11
300,000	1	4½d	Lambert Bros., Ltd., Ord.	1	⅝— ⅞
50,000	5	2/9	Do. 5½% Cum. Pref.	5	4 — 4½
40,000	3	2/1½	Leeds Forge Co., 7% Cum. Pref. ..	3	3¾— 4¼
200,000	1	7½d.	Lysaght (John), Ltd., 6% Cum. Pf.	1	1 5/16— 1 7/16
£300,000	Stk	4½%	Do 4½% 1st Mt. Deb. Stk., Red.	100	108 —110
40,000	10	5/-	Mather & Platt, Ld., 5% Cum. Pref	10	11 — 11½
210,000	1	6d.	Measures Bros., Ltd., Ord.	1	11/16— 13/16
75,000	1	6⅝d.	Do. 5½% Cum. Pref.	1	13/16— 15/16
£75,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	94 — 97
21,943	5	2/6	Muntz Metal, Ltd.	5	5½— 5¾
14,248	5	5%	Do. Pref. 5%	5	5⅛— 5⅜
5,000	62½	47/6	Nantyglo and Blaina Iron Works, Ltd., 8% Cum. Pref.	62½	74 — 76
7[illegible],000	10	5/-	N. Brit. Loco. Co., Ltd., 5% Cm Pf.	10	11⅞— 12⅛
8[illegible],000	5	—	North-Eastern Steel Co., Ltd., Ord.	5	—
£25[illegible],000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	90 — 93
122,000	5	2/-	Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B"	5	3¾— 4
50,000	5	3/-	Do. 6% Cum. Pref. "A" ..	5	5¾— 6¼
70,000	10	6/-	Pease & Partners, Ltd., Ord. ..	10	10 — 10½
£400,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	97 —100
20,000	5	3/-	Peebles (Bruce) & Co., Ld., 6% Cm. P.	5	4¾— 5
65,000	1	—	Pooley (Henry) & Son, Ltd., Ord ..	1	5/-—6/-
13,000	5	—	Do. 5½% Cum. Pref.	5	4¼— 4¾
230,000	1	—	Projectile Co. (1902), Ltd., Ord. ..	1	½— ⅝
126,938	5	2/-	Rhymney Iron Co., Ltd.	5	1⅞— 2
73,062	5	2/-	Do. New	5	1½— 1¾
£330,000	—	5%	Do. 5% Mort. Deb., Red. ..	100	99 —102
350,000	1	7½d.	Richardsons, Westgarth & Co., Ltd., 6% Cum. Pf. ..	1	⅞— 15/16
£350,000	Stk	4½%	Do. 4½% Perp. Deb. Stock ..	100	94 — 96
35,000	10	12/-	Ruston, Proctor & Co., Ltd... ..	10	9½— 9¾
275,000	1	6d.	Scott (Walter), Ltd., Ord.	1	⅞— 1
300,000	1	7½d.	Do. 6% Cum. Pref. ..	1	1— 1⅛
£300,000	Stk	4%	Do. 4% Perp. Deb. Stk	100	94 — 96
£115,300	100	5%	Shelton Iron, Steel and Coal Co., Ld. 1st Charge 5% Debs.. Red ..	100	91 — 94
£97,900	100	6%	Do. 6% 2nd Mort. Debs., Red.	100	91 — 95
250,000	1	1/-	South Durham Steel & Iron, Ltd. Or.	1	⅝— 11/16
300,000	1	7½d.	Do. 6% Cum. Pref...	1	⅞ — 15/16
£300,000	Stk	4½%	Do. 4½% Per. Deb. Stock	100	89 — 92
49,560	10	2½%	Steel Co. of Scotland Ord. 1/49560..	9	5½— 5⅝
£125,240	Stk	5%	Do. 5% Trust Mort. Deb. ..	100	106½—107½
25,000	10	—	Stephenson (Robert) & Co., Ltd., Or.	10	3½ — 3¾
25,000	10	5/6	Do. 5½% Cum. Pref. ..	10	6¼— 6¾
£250,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	83— 86
85,000	10	9/-	Stewarts & Lloyds, Ltd., Ord. ..	10	16¾— 17¼
55,000	10	6/-	Do. 6% Cum. Pref. .. .	10	14¼— 14¾
634,732	1	4.69d.	Swan, Hunter & Wigham-Richardson, Lim. Ord.	1	⅞— 1
538,845	1	6d.	Do. 5% Cum. Pref. .. .	1	15/16— 1 1/16
£240,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Red	100	98 — 101
300,000	1	6d.	Thames Iron Works, Shipbuilding & Engineering Co., Ltd., 5% Cum. Pf.	1	½— 9/16
£200,000	100	4%	Do. 4% Irredeem. 1st Mort. Deb.	100	67 — 71
£160,000	1	7½d.	Thornycroft (John I.) & Co., Ltd. 6% Cum. Pref.	1	15/16— 1 1/16
10,000	10	5/-	Tylor (J.) & Sons, Ltd. 5% Cum. Pf.	10	9½— 10
$508495200	$100	$½	United States Steel Corp. Com. Stk.	$100	34½— 34⅞
$360314100	$100	$1¾	Do. 7% Cum. Pref. Stock	$100	97¾—98¼*
$162268000	$1000	5%	Do. 10-60yr. 5% Skg. Fd. G. Bds.	$1000	97 — 99
3,350,000	1	1/-	Vickers, Sons & Maxim, Ltd. Ord..	1	2 7/16— 2 9/16
750,000	1	6d.	Do. 5% Non-Cum. Pref. ..	1	1⅛— 1¼
£750,000	Stk	5%	Do. 5% Non-Cum. Pref. Stock.	100	114 —117
£1,250,000	Stk	4%	Do. 4% 1st. Mort. Deb. Stk. Red.	100	105 —107
£1,000,000	100	4½%	Do. 4½% 2nd Mort. Debs., Red.	100	105 —107
225,000	1	1/2⅝	Weardale Steel, Coal & Coke, Ltd., Def. Ord.	1	13/16— 15/16
500,000	1	7½d.	Do. 6% Cum. Pref. Ord. ..	1	⅞— 1
£300,000	Stk	4%	Do. 4% Perpetual Deb. Stock	100	85 — 89
7,637	5	2/9	Weldless Steel Tube, Ltd., Cum. Pref. 5½	5	4¾— 4⅞
300	Stk	4½%	Do. Mort. Deb. 4½%	100	91 — 97
66,666	5	3/.	Willans & Robinson, Ord.	5	1½— 2½
66,666	5	3/-	Do. 6% Cum. Pref.	5	3 — 4
£246,641	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red	100	77 — 82
£150,000	Stk	4½%	Yorkshire Iron & Coal Co., Ltd., 4½% 1st Mort. Deb. Stk. Red.	100	81 — 86

Stocks and Shares marked * are quoted ex-dividend.

II.—ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name	Paid up.	Closing Prices.
70,000	1	6d.	Alliance Elec. Co., Ltd. 5% Cum. Pf.	1	⅝—⅞
125,000	1	7½d.	Aron Elec. Meter Ltd., 6% Cum. Pf.	1	7/16—9/16
120,000	1	9⅜d.	Bell's Asbestos Co., Ltd.	1	⅝—¾
100,000	5	4/-	British Insulated & Helsby Cables Ltd., Ord.	5	5¾—6¼
100,000	5	3/-	Do. 6% Cum. Pref.	5	5½—5¾
£500,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Rd.	100	101 —104
£200,000	Stk	4½%	British Thomson-Houston Co., Ltd., 4½% 1st Mort. Deb. Stk. Red.	100	101 —103
400,000	5	3/-	British Westinghouse Electric and Manufac. Co., Ltd., 6% Pref.	5	2½— 2¾
£616,358	Stk	4%	Do. 4% Mort. Deb. Stk. Red.	100	87 — 89
105,731	2	2/-	Brush Elec. Enging. Co., Ltd., Ord.	2	½— ¾
150,000	2	2/4⅘	Do. 6% Pref.	2	1½— 1¾
£125,000	Stk	4½%	Do. 4½% Perp. 1st Deb. Stk.	100	94 — 97
£125,000	Stk	4½%	Do. 4½% Perp. 2nd Deb. Stk.	100	79 — 82
35,000	5	5/-	Callender's Cable & Constn. Ltd. Ord.	5	10½ - 10¾
40,000	5	2/6	Do. 5 % Cum. Pref.	5	5⅜ - 5⅝
£200,000	Stk	4½%	Do. 4½% 1st Mort. Deb Stk. Red.	100	105 —107
85,000	3	1/6	Crompton & Co., Ltd.	3	2⅛— 2⅜
£100,000	—	5%	Do. 5% 1st Mort. Reg. Debs.	100	93— 98
52,000	5	10/-	Dick, Kerr & Co., Ltd., Ord.	5	7¾— 8¼
61,000	5	3/-	Do. 6% Cum. Pref.	5	5⅞— 6⅛
£300,000	Stk	4½%	Do. 4½% Deb. Stock, Red.	100	105 —107
233,334	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	1⅛— 1⅜
£233,334	Stk	4%	Do. 1st Mort. 4% Iree. Deb. Stk.	100	105 —108
99,261	5	1/6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	3	⅝— ⅞
17,189	5	2/6	Do. "A" Shares Nos. 01-017,189	5	1 — 1½
£344,028	Stk	4%	Do. 4% Deb. Stock Red.	100	77 — 82
£100,000	Stk	5%	Do. 5% Second Deb. Stk. Red.	100	79 — 84
112,100	2	1/7⅕	Electric Construction Co., Ltd.	2	1⅛— 1¼
81,890	2	2/9⅗	Do. 7% Cumulative Pref.	2	2¼— 2½
£200,000	Stk	4%	Do. 4% Perp. 1st Mt. Deb. Stk.	100	97 — 99
10,248	10	7/6	Evered and Co., Ltd.	10	13 — 15
£100,000	Stk	5%	Ferranti, Ltd., 5% 1st Mort. Deb. Stock, Red.	100	90 — 95
25,000	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9½— 10
£200,000	Stk	4%	Do. 4% 1st. Mt. Deb. Stk.. Red.	100	91 — 96
35,000	5	5/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	12 — 12½
35,000	5	2/3	Do. 4½% Cum. Pref.	5	5⅜— 5⅝
£50,000	Stk	4½%	Do. 4½% Mt. Deb. Stk. Red.	100	111 —113
50,000	10	5/-	India Rubber, Gutta Percha & Telegraph Works Co., Ltd.,	10	15½— 16½
£300,000	100	4%	Do. 1st Mort. Deb. Red.	100	100 —103
7,500	10	—	Parker, Thos., Ltd.	10	6½— 7
100,000	1	3%	Scott (Ernest) & Mountain, Ld., Ord.	1	16/—16/6
37,350	12	12/-	Telegraph Construction and Maintenance Co., Ltd.	12	34 — 36
£150,000	100	4%	Do. 4% Deb. Bonds	100	101½-103½

III.—ELECTRIC TRACTION.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
120,000	5	8/-	Anglo-Argentine Trams Co., Ld., Or.	5	8¼— 8½
260,007	5	2/6	Do. 5% Cum Pf.	5	5⅝— 5⅞
£230,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888	100	140 —143
20,000	10	6/-	Barcelona Trams Co., Ltd., Ord.	10	11¾— 12¼
10,000	10	5/-	Do. 5% Cum Pf. Shares	10	9 -- 10
£46,800	100	5%	Do. 5% Debs., Red.	100	99 --102
£191,826	Stk	4½%	Do. 4½% Red. Deb. Stk.	100	96 —100
75,606	1	—	Bath Elec. Trams. Ld., Pf. Or.	1	11/16— 13/16
59,894	1	11·49d	Do. 5% Cum. Pf.	1	15/16— 1 1/16
75,000	5	—	Brisbane Electric Tram Investment Co., Ltd., Ord.	5	1¼— 1¾
75,000	5	2/6	Do. 5% Cum. Pf.	5	3¾— 4¼
£425,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	94 — 98
£200,000	Stk	6%	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	102 —105
		%	Pref. Ord. Stock	100	100 —103
133,801	10	6/-	Brit. Electric Traction, Ltd., Ord.	10	9½— 9¾
156,487	10	6/-	Do. 6% Cum. Pref.	10	11 —11¼*
£1,000,000	Stk	5%	Do. 5% Perp. Deb. Stk.	100	120 —122
£250,000	Stk	4½%	Do. 4% 2nd Deb. Stk. Red.	100	97 — 99
100,000	5	1/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	3¾— 4
40,500	5	8/-	Do. "A" 6% Cum Pref.	5	5⅜— 5⅞
27,000	5	8/-	Do. "B" do.	5	5¼— 5½

ELECTRIC TRACTION.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£200,000	Stk	5%	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	94 — 97
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	99 —102
102,268	5	8/-	Calcutta Tramways Co., Ltd.	5	8¾— 9
£350,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	106 —108
480,000	1	6d.	Cape Electric Tramways, Ltd.	1	1⅛— 1⅜
40,000	5	2/6	City of Birmingham Trams Co., Ltd. 5 % Cum. Pref.	5	4⅞— 5⅛
£300,000	100	4%	Do. 4% 1st Mort. Debs.	100	101 —104
£120,000	Stk	5%	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	101 —104
60,000	10	6/-	Dublin United Trams. Co. (1896), Ltd., Ord.	10	13 — 14
59,987	10	6/-	Do. 6% Pref.	10	15½— 16½
80,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	3½— 3¾
£150,000	Stk	4%	Do. 4% Deb. Stock	100	90 — 93
125,000	10	5/-	London United Trams. (1901), Ltd., 5% Cum. Pref.	10	10⅛—10⅜
£1,031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	103 —105
£50,000	Stk	5%	Madras Electric Trams (1904), Ltd., 5% Deb. Stock, Red.	100	101 —103
814,016	1	—	Metropolitan Elec. Trams, Ltd., Def.	1	11/16—13/16
500,000	1	6d.	Do. 5% Cum. Pref.	1	15/16— 1
£350,000	Stk	4½%	Do. 4½% Deb. Stock, Red.	100	104 —106
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	¾— 1¼
110,923	8	2/9⅗	North Metropolitan Tramways Co.	8	4¼— 4¾
£150,000	100	3½%	Do. 3½% Mort. Debs.	100	90 — 95
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red.	100	103 —105
24,500	10	10/-	Potteries Elec. Traction Co., Ld., Or.	10	8 — 9
24,500	10	5/-	Do. 5% Cum. Pref.	10	8½— 9½*
£220,000	Stk	4½%	Do. 4½% Deb. Stk., Red.	100	100 —103

IV.—ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
7,500	10	16/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord.	10	12½— 13
7,500	10	4/6	Do. 4½% Cum. Pref.	10	9½— 10*
7,500	10	6/-	Do. 6% Cum. Second Pf.	10	11 — 12*
£70,000	Stk	4½%	Do. 4½% Deb. Stock Red	100	104 —106
14,000	5	2/-	Bromley (Kent) Elec. Lt. & Pr. Co. Ld	5	5¼— 5¾
£50,000	Stk	4½%	Do. do. 4½% 1st Deb. Stk. Red.	100	101 —104
27,507	5	4/6	Brompton & Kensington Elec. Supply Co., Ltd. Ord.	5	10½— 11
12,493	5	3/6	Do. 7% Cum. Pref. Shares	5	10¼— 10¾
60,000	5	3/-	Calcutta Elec. Sup. Cor. Ltd., Ord.	5	9 — 9½
£288,782	Stk	4%	Central Elec. Sup. Co., Ltd., 4% Gua. Deb. Stk.	100	105 — 108
70,000	5	4/-	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord.	5	8 — 8½
80,000	5	2/3	Do. do. 4½% Cum. Pref.	5	5½— 5¾
£850,000	Stk	4%	Do. do. 4% Deb. Stk. Red.	100	102 —104
44,486	5	2/3	Chelsea Elec. Sply. Co., Ltd., Ord.	5	6¾— 7¼
£150,000	Stk	4½%	Do. do. 4½% Deb. Stk., Red	100	108 —110
70,595	10	5/-	City of London El. Lghtg. Co., Ld., O.	10	12½— 13
40,000	10	6/-	Do. 6% Cum. Pref.	10	13½— 14
£400,000	Stk	5%	Do. 5% Deb. Stk., Red	100	122 —126
£300,000	Stk	4½%	Do. 4½% 2nd Deb. Stk., Red	100	103 —105
40,000	10	4/-	County of London Elec. Supply Co., Ltd., Ord.	10	9 — 9½
30,000	10	6/-	Do. 6% Cum. Pref.	10	12 — 12½
£400,000	Stk	4½%	Do. 4½% Deb. Stk., Red.	100	108 —111
70,000	5	2/6	Edmundson's Elec. Cor. Ltd., Ord.	5	6½ - 6¾
70,000	5	3/-	Do. 6% Cum. Pref.	5	6 — 6½
£300,000	Stk	4½%	Do. 4½% 1st Mort. Db. Stk. Reg	100	106 —108
£80,000	Stk	5%	Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. Stk. Red.	100	86 — 91
10,000		2/-	Folkestone Elec. Supply Co., Ld., O.	5	5½— 6
£50,000	Stk.	4½%	Do. 4½% 1st Deb. Stk., Red.	100	101 —104
15,000	10	—	Havana Electricity Co., Ltd.	10	9½—10½
13,000		3/6	Hove Elec. Lighting Co., Ltd., Ord.	5	7½— 8
£50,000	Stk	4½%	Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock, Red.	100	100—102
150,000	1	—	Kalgoorlie Electric Power & Lighting Corp, Ltd., 6% Cum. Pref.	1	9/16— 11/16
21,000	5	5/-	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord.	5	13 — 13½

Stocks and Shares marked * are quoted ex-dividend.

ELECTRIC LIGHTING AND POWER.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£135,000	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	102 —104
111,000	3	—	London Elec. Supply Corp., Ld., Ord.	3	2¼ — 2¾
60,000	5	3/-	Do. 6% Pref.	5	5¾ — 6
£371,895	Stk	4%	Do. 4% 1st Mort. Db. Stk., Red.	100	98 —100
100,000	10	9/-	Metropolitan Elec. Sup. Co., Ld., Or.	10	18½— 19
76,121	5	2/3	Do. 4½% Cum. Pref.	5	5⅜ — 5¾
220,000	Stk	4½%	Do. 4½% 1st Mort. Db. Sk., Red.	100	110 —115
250,000	Stk	3½%	Do. 3½% Mort. Deb. Stk., Red.	100	96 — 98
£250,000	—	4½%	Midland Elec. Corp. for Power Distribution. Ld., 4½% 1st Mort. Deb.	100	97 —100
10,852	10	6/-	Notting Hill Elec. Ltg. Co. Ltd. Ord.	10	14½— 15
£59,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	102 —104
16,500	5	2/6	Oxford Electric Co. Ltd., Ord. ..	5	6¼— 6½
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	98 —100
£84,700	100	4½%	Royal Elec. Co. (of Montreal) 4½% 20-yr. 1st Mort. Deb	100	100 —102
40,000	5	5/-	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	13¾—14¼
20,000	5	3/6	Do. 7% Pref...	5	8½— 9
£150,000	Stk	3½%	Do. 3½% Deben. Stock, Red	100	98 —100
12,000	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2¾— 3¼
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	79 — 83*
65,000	5	3/-	South London Elec. Sup. Co., Ltd. O.	5	4⅛— 4⅜
100,000	1	—	South Metropolitan Elec Light & Power Co., Ltd. Ord.	1	⅞ — 1
50,000	1	8⅖d.	Do. 7% Cum. Pref.	1	1⅜— 1 7/16
£100,000	Stk	4½%	Do. 4½% 1st Deb. Stock Red.	100	107 —110
50,000	5	2/6	Urban Electric Supply Co., Ltd., O.	5	5 — 5⅜
30,000	5	2/6	Do. 5% Cum Pref.	5	5⅛— 5¼
£200,000	Stk	—	Do. 4½% 1st Mort. Deb. Stk. Red	100	105 —107
110,000	5	6/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	13¼— 13¾
28,151	5	2/6	Do. 5% Cum. Pref.	5	6⅛— 6⅜

V.—TELEGRAPH & TELEPHONE COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£34,800	100	4%	African Direct Tel. Co., Ld., 4% Mt. Debs. (Series A), Red.	100	99 —102
25,000	10	—	Amazon Telegraph Co., Ld... ..	10	1½— 2
£763,580	Stk	17/6	Anglo-American Tel. Co., Ltd., Ord.	100	59 — 61*
£3,118,210	Stk	35/-	Do. 6% Preferred Ordinary	100	105 —107*
£3,118,210	Stk	2/-	Do. Deferred Ordinary ..	100	13¾— 14
44,000	5	3/-	Chili Telephone Co., Ltd.	5	6⅜— 6⅝
$15,000,000	$100	$2	Commercial Cable Co., Capital Stk.	$100	170 —190
£1,903,856	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	96 — 98
16,000	10	5/-	Cuba Submarine Tel. Co., Ld., Ord.	10	8¾— 9¼
6,000	10	10/-	Do. 10% Preference	10	17 — 18
6,000	5	2/-	Direct Spanish Telegraph Co., Ord.	5	3⅜— 3⅝
		5/-	10% Cum. Preference	5	8 — 8½
£30,000	50	4½%	Do. 4½% Debs...	50	100-102%
60,710	20	3/-	Direct U.S. Cable Co., Ltd... ..	20	11 —11½
£85,800	100	4½%	Direct West India Cable Co., Ltd., 4½% Reg. Debs.	100	99 —101
£300,000	100	4%	East. & S. African, Ld., 4% Mt. Dbs.	100	100—102
£200,000	25	4%	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)..	25	101-103%
300,000	10	2/6	Eastern Extension, Australasia and China, Ltd...	10	13¾— 14¼
£602,400	Stk	4%	Do. 4% Mort. Deb. Stk., Perp.	100	104 —106
£4,000,000	Stk	25/-	Eastern Tele. Co., Ltd., Ord. ..	100	140 —143
£2,000,000	Stk	17/6	Do. 3 % Pref.	100	88 — 90
£1,836,814	Stk	4%	Do. 4% Mort. Deb.	100	106 —108
150,000	10	5/-	Great Northern Telegraph Co., Ltd., (of Copenhagen) ..	10	30 — 30½
£58,700	100	4½%	Halifax and Bermudas Cable Co., Ltd., 4½% 1st. Mort. Debs. Red.	100	100—102
17,000	25	12/6	Indo-European Tele. Co., Ltd. ..	25	46 — 48
72,680	1	7½d.	Monte Video Telephone Co., Ltd., O.	1	13/16— 15/16
£1,983,333	Stk	6%	National Telephone Co., Ltd., Pref.	100	109½—110½
£1,966,667	Stk	5%	Do. Deferred	100	104—106
250,000	5	2/6	Do. 5% Non-Cum. 3rd Pref.	5	5¼ — 5½
£2,000,000	Stk	3½%	Do. 3½% Deb. Stk., Red. ..	100	97 — 99
£689,593	Stk	4%	Do. 4% do. do. ..	100	102 —104
179,313	1	7½d.	Oriental Telephone & Elec. Co., Ltd.	1	1 1/16— 1 3/16
50,000	1	7½d.	Do. 6% Cum. Pref.	1	1 3/16 – 1 5/16
£100,000	100	4%	Pacific & European Tel. 4% Guar. Debs. Red...	100	98 —101
11,839	8	4/-	Reuter's Telegram Co., Ltd. ..	8	7¼— 7¾
58,000	5	3/-	United River Plate Telep. Co., Ltd.	5	7¼— 7¾
40,000	5	2/6	Do. 5% Cum. Pref.	5	5 — 5¼
£179,947	Stk	5%	Do. 5% Deb. Stock, Red. ..	100	106—108
15,609	10	4/-	W. African Telegraph Co., Ltd. ..	10	7¼— 7¾
£30,008	2½	—	West Coast of America, Ltd. ..	2½	5/16— 7/16
150,000	100	4%	Do. 4% Deb. Guar. by West. Tel.	100	99 — 101

TELEGRAPHS AND TELEPHONES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name	Paid up.	Closing Prices.
88,321	10	6d.	W. India & Panama Teleg. Co., Ld., Or.	10	11/16 - 13/16
34,563	10	6/-	Do. 6% Cum. 1st. Pref. ..	10	7¾ - 8¼
4,669	10	6/-	Do. 6% Cum. 2nd Pref. ..	10	7¼— 7¾
£80,000	100	5%	Do. 5% Deb.	100	102 —104
207,930	10	3/-	Western Telegraph Co., Ltd. ..	10	13½— 14
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	101 —103
518,915	Stk	4%	Do. 4% Deb. Stock, Red. ..	100	102 —104

VI.—SHIPPING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	losing Prices.
32,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 5½% Cum. Pref.	10	8½— 9
£325,000	Stk	4½%	Do. 4½% Red. 1st Mort. Deb. Stk.	100	99 —101
£672,900	Stk	4½%	British & African Stm. Nav. (1900) Ltd., 4½% 1st Mort. Deb. Stk., Red.	100	93 — 95
40, 000	10	5/6	Bucknall Steamship Lines, Ltd., 5½% Cum. Pref.	10	6 — 6½
£600,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk.	100	74 — 77
£750,000	Stk	4½%	Clan Line Steamers, Ltd., 4½% Deb. Stk. Red. ..	100	98 —100
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000..	20	13¾— 14¼
40,000	20	8/-	Do. Nos. 60,001-100,000	10	6 — 6½
£451,430	Stk	4½%	Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. ..	100	101 —103
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord...	1	1 3/16—1 5/16
25,328	7½	4/7	Gen. Steam Navigation Co., Ld., Ord.	7½	4¼— 4¾
36,758	8	4/9⅗	Do. Non-Cum. 6% Pref.	8	7½— 8
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	97 — 99
55,000	5	1/3	Houlder Line, Ltd., Ord.	5	2½— 3
40,000	5	2/9	Do. 5½% Cum. Pref.	5	3¼— 3¾
£200,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk. Red.	100	83 — 86
141,500	10	5/-	Leyland (Fredk.), & Co., (1900), Ltd., 5% Cum. Pref. ..	10	4¾— 5¼
£1,160,000	Stk	5 %	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. ..	100	129 —132
£1,160,000	Stk	19%	Do. do. Deferred ..	100	222 —225
15,000	100	30/-	Royal Mail Steam Packet Co. Ord..	60	25½— 26½
39,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref..	5	4¾— 5¼
39,075	5	2/6	Do. "B" Ord...	5	4 — 4½
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord..	10	8¼— 8¾
24,000	10	4/6	Do. 4½% Cum. Pref... ..	10	9¾— 10¼
£1,008,894	Stk	4%	Do. 4% Debenture Stk., Red.	100	99 —101

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
60,000	1	9⅗d.	Chadburn's (Ship) Tele. Ltd., Ord...	1	⅞— 1⅛
£750,000	Stk	5%	General Hydraulic Power Co., Ltd.	100	136 —141
12,500	10	10/-	Oakey (John) and Sons, Ltd., Ord..	10	24 — 26
10,000	10	6/-	Do. do. 6% Cum. Pf.	10	14 — 15
183,538	1	6·3d.	Power Gas Corp., Ltd., Ord., Nos. 66,463-250	15/-	5/16— 7/16
66,462	1	8·4d.	Do. do. Nos. 1 66,462	1	9/16— 11/16
135,000	1	6d.	Waygood (R.) & Co., Ltd., Ord. ..	1	1 1/16— 1 3/16
135,000	1	7½d.	Do. 6% Cum. Pref. ...	1	1⅛— 1¼

RAILWAY CARRIAGE & WAGON COMPANIES.

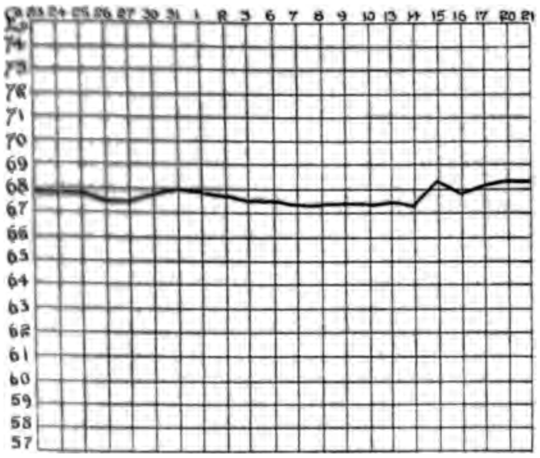
Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices
10,000	10	7/6	Birm. Railway-Car. & Wagon, L., 1-10,000	10	21½— 22½
8,739	10	3/-	Do. Second Issue 1-8,739....	4	8½— 9
10,000	10	6/-	Do. Cum. Pref. 6% 1-10,000..	10	13 — 13½
30,111	7	7/-	Gloucester Rail.-Car & Wagon, Ld., A, 1-29,861 & 49,751-50,000	7	9 — 9½*
44,889	7	3/6	Do. B, 29,862-49,750, 50,001-75,000	7	4 — 4½*
14,567	10	1/3	Lancashire Wagon, Ord.	2	2 7/16—2 9/16
4,150	10	5%	Do. do.	10	10¾—10 15/16
781,808	1	9d.	Metropolitan Amalgamated Rail.-Carriage & Wagon, Ld., 1-784,808	1	42 —42/6
164,288	1	6d.	Do. Cum. A Pref. 5% 1-164,288	1	23/6—24/6
235,000	1	7½d.	Do. Cum. B Pref. 6% 1-235,000	1	28/—28/6
20,000	20	20/-	Midland Rail.-Car. & Wagon, Ld., 1-20,000	10	19 —19½*

Stocks and Shares marked * are quoted ex-dividend.

THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM JANUARY 23RD TO FEBRUARY 21ST, 1905.

COPPER.



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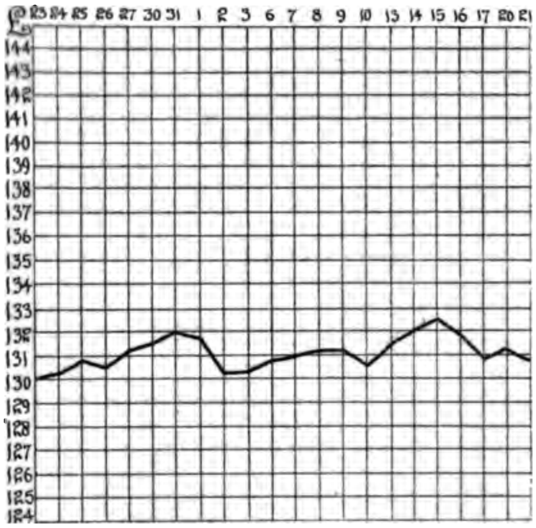
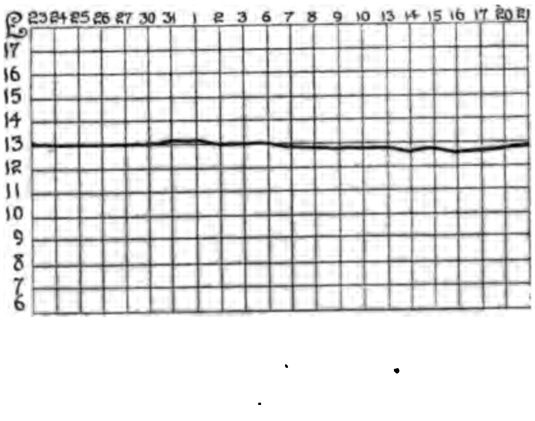


ENGLISH LEAD.



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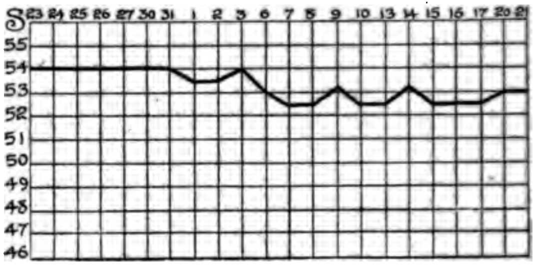

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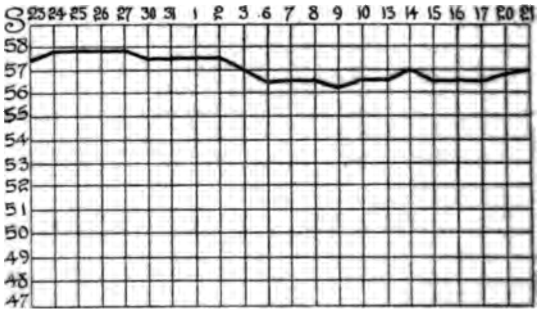
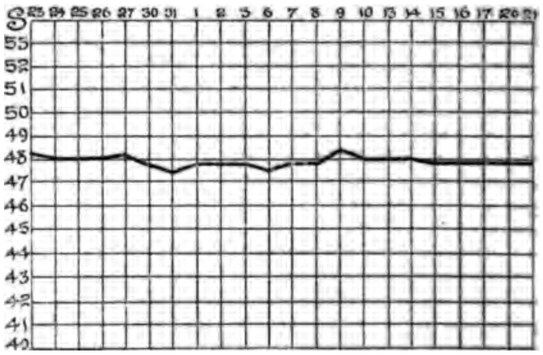


CLEVELAND.



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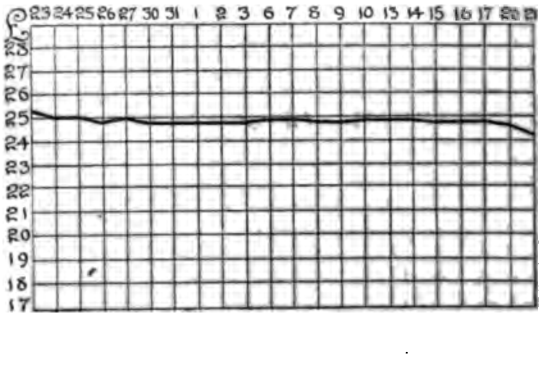


PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

MARKET REPORT.

Wednesday, February 22nd, 1905.

THE higher prices for copper, which it was suggested in this column last week would be seen in the immediate future, are already with us. Indeed there has been a tendency to push quotations up too rapidly, the first signs of speculative buying causing a rise from £67 15s. for three months' standard to £68 15s. The quotation remains at about this level, but an early resumption of the buying movement is suggested by trading requirements, and copper ought then to touch a higher level.

Tin shows rather more activity on the revival in copper, and at one time as high as £132 10s. had to be bid for near delivery. A sharp relapse followed, but on more encouraging advices from the East the tone is now firmer. The bear arguments in a circular emanating from an American source, which was scattered broadcast last week, should not be regarded too seriously. The predictions of large additions to supplies appear to be based on misconception. The closing price fine foreign, cash, is £131 5s.

Large arrivals of Lead have caused a sharp fall in quotations, holders preferring to make sacrificing sales in preference to warehousing the metal.

Spelter is steady but business has been restricted. The settlement of the Silesian strike has relieved consumers of the fear of a dwindling supply.

In the Iron and Steel section a large speculative business is being done on the iron market, but looking to the large character of transactions, movements in prices have been of a comparatively unimportant character. Middlesbrough stocks continue to increase, the figures now standing at 260,359 tons against 250,506 tons a week ago. There is very little fresh to report on the general trade position. The advices from America are good and provincial correspondents write hopefully of the outlook, although at the present moment an easier tendency is noticeable.

The Timber trade shows signs of revival, but the higher prices which are being asked by shippers in view of the shipbuilding boom are rather previous.

Coal is a dull market; steams are quiet, and the Welsh market generally is inactive.

IRON, STEEL, PIG-IRON, &c.

SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as follows. Prices delivered in Glasgow or equal:—

	£	s.	d.
Steel:			
Siemens' Steel Plates, Marine Boiler Quality	6	15	0
,, ,, ,, Land ,, ,,	6	17	6
,, ,, ,, Ship Quality Plates	5	17	6
Siemens' Steel Bars, Boiler Quality	6	17	6
,, ,, ,, Ship ,,	6	7	6
,, ,, Angles	5	7	6
Manufactured Iron:			
Bars—Dalzell	6	2	6
,, Best	6	12	6
,, ,, Horseshoe	6	12	6
,, Angle	6	2	6
,, Best Angle	6	12	6
,, Best Best	7	2	6
,, Extra Best	7	12	6

Usual terms and extras. Special rates for delivery in England and export. The above prices subject to alteration without notice.

The Glasgow Iron and Steel Co., Ltd., Wishaw, quote as under (prices are delivered Glasgow or equal):—

	£	s.	d.	
Steel Angles (Glasgow ♔ Steel)	5	7	6	per ton.
Steel Ship Plates (Glasgow ♔ Steel)	5	17	6	,,
Steel Bars, Ship Quality (Glasgow ♔ Steel)	6	7	6	,,
Steel Bars, Boiler Quality (Glasgow ♛ ♛ Steel)	6	17	6	,,
Steel Land Boiler Plates (Glasgow ♛ ♛ Steel)	6	7	6	,,
Steel Marine Boiler Plates (Glasgow ♛ ♛ Steel)	6	7	6	,,

Less 5 per cent. discount. Extras as per standard list.

Special prices for delivery in England and for export. The above prices subject to alteration without notice.

John Spencer (Coatbridge), Ltd., Phœnix Ironworks, Coatbridge, N.B., quotes:—

	£	s.	d.
Bars—Phœnix	6	5	0
,, Best	6	15	0
,, Best Best	7	5	0
,, Extra Best	7	15	0
,, Best Horse Shoe	6	15	0
,, Extra B.H.S.	7	15	0
,, Extra Best Cable	8	5	0
,, Rivet	6	5	0
,, Best Scrap Rivet	7	5	0

	£	s.	d.
Angles—Phœnix	6	5	0
,, **Best**	6	15	0
,, **Extra Best**	7	5	0
Gas Tube Hoops—Phœnix Best	6	15	0
Plates—Phœnix	—		
,, Best Boiler	7	10	0
,, Best Best Boiler	8	0	0
,, Extra Best Boiler	9	0	0
Boiler Tube Strips—Phœnix Best Best	8	0	0

All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly.

Messrs. R. Feldtmann and Co., of Glasgow, quote Commission extra).

Pig Iron:	No. 1.			No. 3.		
	£	s.	d.	£	s.	d.
Coltness, f.a.s. Glasgow	3	4	6	2	14	0
Gartsherrie ,,	2	19	0	2	14	0
Summerlee ,,	2	19	0	2	14	0
Carnbroe ,,	2	16	6	2	12	6
Langloan ,,	3	4	0	2	15	0
Calder ,,	2	19	0	2	13	6
Clyde ,,	2	18	6	2	13	6
Glengarnock, f.o.b. Ardrossan	2	18	6	2	12	6
Eglinton ,, ,,	2	14	6	2	12	6
Dalmellington, ,, Ayr	2	14	6	2	12	6
Shotts ,, Leith	2	19	0	2	14	6

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, **at works**:—

	£	s.	d.
W.W. ♛ Bars	6	12	6
W.W. Best Bars	7	2	6
W.W. Best Best	7	12	6
W.W. Best Best Best	8	2	6
W.W. Best Shoe	7	2	6
Thornaby ♛	8	2	6
Thornaby Best	8	12	6
Thornaby Best Best	9	12	6
Whitwell Special Admiralty Cable	10	5	0
Special Chain Iron	9	5	0
Tube and Nail Strips	6	15	0
W.W. ♛ Angle Iron	6	15	0
W.W. Best Angle Iron	7	5	0
Tee Iron, to 8-inches United	7	12	6

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington, quote:—

	Iron.			Steel.		
	£	s	d.	£	s.	d.
♛ (8F) Bars	6	10	0	7	5	0
,, ,, Angles	7	0	0	7	5	0
,, ,, Tees	7	10	0	7	15	0
♛ WIW Hoops	7	0	0	7	10	0
,, ,, Sheets	7	10	0	8	0	0

Ordinary Sizes, F.A.S. Liverpool in 10-ton Lots.
Extras for Sizes and Cutting as per List.

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

Black Sheets:	Singles 20 G 96in. by 36in. per ton.			Doubles 21 G to 24 G 96in. by 36in. per ton.		
	£	s.	d.	£	s.	d.
"Vale"	10	0	0	10	10	0
"Shield"	10	10	0	11	10	0
"Severn"	11	10	0	12	10	0
"Baldwin Wilden B."	12	10	0	13	10	0
Charcoal	16	10	0	17	10	0
Best Charcoal	18	10	0	19	10	0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:	£	s.	d.	£	s.	d.
No. 3 Lead	13	10	0	14	10	0
S.V. Lead	15	0	0	16	0	0
No. 3 Terne	15	0	0	16	0	0
S.V. Terne	16	10	0	17	10	0

Tinned Sheets:	Singles 20 G to 108 by 36in. per ton.			Doubles 21 to 24 G to 96 by 36in. per ton.		
	£	s.	d.	£	s.	d.
Best Coke (Finish)	28	0	0	29	10	0
,, Charcoal (Finish)	30	0	0	31	10	0
Extra ,, ,,	32	0	0	33	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.

Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box.

Extreme sizes in Tin and Patent Coated specially quoted for.

Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.

At works less 2½% for cash monthly, 10th inst.

Galvanized Corrugated Sheets:

	£	s.	d.	
"Phœnix" Brand, 24 G., f.o.b. London, in Bundles	11	15	0	per ton.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	14	7	6	,,

Galvanized Working Up-Sheets:

	£	s.	d.	
24 G., f.o.b. London, in Bundles	13	15	0	per ton.

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£	s.	d.	
Crown Bars	6	10	0	per ton.
Best Bars (1 to 6in. wide, above ½ in. thick, ½ in. to 4 rounds and squares)	7	0	0	,,
Angles	6	15	0	,,
,, Best	7	5	0	,,
T's	7	0	0	,,
,, Best	7			
Best Shoe Iron				
,, Rivet Iron				
,, Best Rivet (Special)				
,, Cable				
,, Screwing				

	£	s.	d.	
Best Turning	8	0	0	per ton.
,, Plating	8	5	0	,,
,, ,, Best Best	9	5	0	,,
,, ,, Treble	10	5	0	,,
Plates	7	10	0	,,
Best Plates	8	0	0	,,
,, Boiler Plates	8	10	0	,,
,, Best Boiler Plates	9	10	0	,,
Treble Best Boiler Plates	12	0	0	,,

Delivery f.o.b. Liverpool, Birkenhead or Manchester.

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon., quote "Star" brand patent wrought nails, steel nails, &c.

Discounts—

45 per cent. off 1-inch to 3-inch strong rose and all fine rose and 6dy. and 8dy. pound.

40 per cent. off 3½ inch to 7-inch strong rose and 10dy. and 20dy. pound.

40 per cent. off all sharp-pointed nails.

Delivered in lots of 4 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis:—

2 tons 9/6 per cwt.
4 cwt. lots and upwards 9/9 per cwt. } d/d any Railway Station.

Steel cut nails, 3-inch basis—

2 tons 8/3 per cwt.
4 cwt. lots 8/6 per cwt. } d/d any Railway Station.

Slit rods (iron) £7 10s. per ton, at works for 2-ton lots.

Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E. C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla, quote:—

	Per Box. f.o.b. Wales. £	s.	d.
Coke Tin-plates.			
C 18¾ by 14 124s. 110 lb. "BV"	0	12	9
C 20 by 10 225s. 155 ,, "Jumbo"	0	17	9
C 20 by 14 112s. 108 ,, "Lydbrook"	0	12	3
C 28 by 20 112s. 216 ,, "Lydbrook"	1	4	9
Charcoal Tinplates:			
C 20 by 14 112s. 108 lb. "Allaway"	0	13	0

BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes:—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

		£	s.	d	
Steel:					
Blooms	at	3	12	0	per ton.
Billets	at	3	14	0	,,
Sheet Bars	at	3	16	0	,,
Finished Steel:					
Bars	at	5	0	0	per ton.
Angles	at	5	1	0	,,
Tees	at	5	4	0	,,
Joists	at	4	10	0	,,
Fencing Standards	at	5	2	0	,,
Shoeing Bars	at	5	4	0	,,
Tyre Bars	at	5	4	0	,,
Half-Round Bars	at	5	5	0	,,
Heavy Rails	at	4	15	0	,,
Light Rails	at	4	17	6	,,

Structural Steelwork:

Prices on application.

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote:—

TIN.

Tin:	£	s.	d.		£	s.	d.	
English Ingots, f.o.b. Dis. 1¼% & 1%	131	10	0	to	132	0	0	per ton.
English Bars, f.o.b. Dis. 1¼% & 1%	132	10	0	to	133	0	0	,,
Straits G.M.B., cash Warehouse, Net	130	17	6	to	131	0	0	,,
Straits G.M.B., 3 months, Warehouse, Net	130	2	6	to	130	5	0	,,
Australian, Mr. Bischoff, Warehouse, Net	131	10	0	to	131	15	0	,,

COPPER.

Copper:	£	s.	d.		£	s.	d.	
Standard G.M.B., cash Warehouse, Net	68	2	6	to	68	3	9	per ton.
Standard G.M.B., 3 months, Warehouse, Net	68	10	0	to	68	11	3	,,
English, Tough, Cake & Ingot, Warehouses, Net	70	10	0	to	71	0	0	,,
English, Best Select, Warehouse Net	71	0	0	to	72	0	0	,,
English, Sheets and Sheathing, f.o.b., Dis. 2½%	80	0	0	to	80	10	0	,,
English, Sheets for India, f.o.b., Dis. 2½%	76	0	0	to	76	10	0	,,
Electro, Warehouse, Net	70	15	0	to	71	0	0	,,
Ore, ex. ship	0	12	0	to	0	13	0	per unit.
Regulus, Matte and Precipitate, ex. ship,	0	13	3	to	0	14	0	,,

YELLOW METAL.

Yellow Metal:	£	s.	d.	£	s.	d.	
Sheets, 4 by 4 feet for India f.o.b. Dis. 2½%				0	0	6¾	per lb.
Sheathing ,, ,,				0	0	6⅞	,,

SPELTER.

	£	s.	d.		£	s.	d.	
Silesian outports, Net	24	15	0	to	25	0	0	per ton.
Blende of 50 % Net	6	16	6	to	7	0	0	,,
Calamine, Net	6	19	0	to	7	0	0	,,

LEAD.

	£	s.	d.		£	s.	d.	
English Pig, Warehouse, Dis. 2½%	12	15	0	to	12	17	6	per ton.
Spanish, ex ship, Dis. 2½%	12	8	9	to	12	10	0	,,
Lead Ore of 70 %, Net	6	4	6	to		—		,,

ANTIMONY.

	£	s.	d.		£	s.	d.	
Star Regulus, f.o.b., Dis. 2½ %	35	10	0	to	36	0	0	per ton.
Ore, 50 %, ex ship, Dis. 2½%	8	10	0	to	9	10	0	,,
Crude, ex ship, Dis. 2½ %	13	10	0	to	14	0	0	,,

QUICKSILVER.

	£	s.	d.	
Spanish, 75 lb., Warehouse, Net	7	12	6	per flask.
Italian ,, ,, ,,	7	11	6	,,

COAL.

LEICESTERSHIRE.

The Nailstone Colliery Company, Leicester, quote. Price per Ton at Pit of 20 Cwt., with ½ Cwt. per Ton for wastage —

Upper Main Seam.	s.	d.
Main Coal	7	6
Best Hard Steam (hand picked, as used by the Railway Companies)	6	0
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)	6	0
Fine Slack	0	6

Terms, net cash on 10th of month following delivery.

DERBYSHIRE.

The Manners Colliery Co., Ltd., of Ilkeston quote as follows, per ton at pit:

Kilburn Coal:	s.	d.
Best London Brights	9	9
Large Nuts (1½ to 3½)	9	6
Small Nuts (¾ to 1½)	6	0
Rough Brights	6	0
Peas (⅜ to ¾)	5	0
Slack	3	6
Smudge	2	0

Low Main (or Tupton) Coal:	s.	d.
Low Main Brights	7	6
,, ,, Nuts	7	3
Hards (Good Steam Coal)	8	0
Bakers' Nuts (1" to 2")	6	6
Slack	3	6

The Clay Cross Company's Collieries, Clay Cross, near Chesterfield, quote:—

	per ton at pit. s.	d.
Best Main Coal	10	6
Best Silkstone	10	0
Best House Coal	8	6
Best House Nuts	8	0
Treble Screened Cobbles	7	9
Best Cobbles	7	3

NOTTINGHAMSHIRE.

The Digby Colliery Co., Ltd., near Nottingham, quote per ton at pit:—

Digby Coal:

STEAM.	s.	d.
Best Hand Picked Hard	9	0
Steam Hard	7	9
Hard Nuts	7	0

Gedling Colliery.

HIGH HAZEL.	s.	d.
London Brights, 4 to 8 in. cube	12	0
Large Nuts, 2 to 4 in. cube	9	6
Small Nuts, ¾ to 2 in. cube	5	6

STEAM.—TOP HARD.	s.	d.
Best Hard	9	0
Hard Steam	8	0
Cobbles	7	0

CHEMICALS AND OILS.

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square, Manchester, quote:

	£	s.	d.	
Acids: Oxalic	0	0	2¾	per lb.
Picric, Crystals	0	0	11	,,
Tartaric .... at Manchester	0	0	10¾	,,

	£	s.	d.	
Acetate of Lime: Brown at Manchester net	9	10	0	per ton.
Grey ,,	11	10	0	,,
Alumina: Alum, Lump, loose	5	5	0	,,
,, ,, in casks	5	7	6	,,
,, Ground, in bags	5	15	0	,,
Sulphate of Alumina, 14%	4	10	0	,,
Ammonia: Carbonate	0	0	3⅜	per lb.
Muriate Grey f.o.b. Liverpool	24	0	0	per ton.
Sal-ammoniac, Lump, 1sts, del^d. U.K.	42	0	0	,,
,, ,, 2nds, ,,	40	0	0	,,
Sulphate .... f.o.b. Liverpool	13	5	0	,,
Arsenic: Best White Powdered ....net	12	5	0	,,
Bleaching Powder, 35% .... ,,	4	10	0	,,
Borax: British Refined Crystal........ ,,	12	0	0	,,

Coal Tar Products:		£	s.	d.	
Benzole, 50/90 %	,,	0	0	8½	per gal.
,, 90%	,,	0	0	10	,,
Carbolic Acid Crystals, 34/35° C.	,,	0	0	6¼	per lb.
,, ,, ,, 39/40° C.	,,	0	0	7½	,,
,, ,, Liquid, 97/99 %	,,	0	0	9	per gal.
,, ,, Crude, 62½% at 60° F. f.o.b.	,,	0	2	0	,,
Creosote, ordinary good liquid	,,	0	0	1½	,,
Naphtha, Crude, 20 % at 120° C.	,,	0	0	3	,,
,, Solvent, 90% at 160° C. f.o.b	,,	0	0	8½	,,
,, ,, 95 % at 160° C. ,,	,,	0	0	9½	,,
,, ,, 90 % at 190° C. ,,	,,	0	0	10½	,,
,, Rectified, flash point over 73° F. ....f.o.b.	,,	0	0	11	,,
,, Rectified, flash point over 100° F. ....f.o.b.	,,		1	0	,,
Naphthalene, all qualities.					
Pitch...............f.a.s. Manchester.	,,	1	11	6	per ton.
Copperas: Green, in bulk	,,	0	12	6	,,
,, barrels f.o.b. L'pool	,,	1	19	0	,,
Cake	,,	1	2	6	,,
Copper: Sulphate		22	15	0	,,
Cyanides: 98% minimum ......f.o.b.	net	0	0	8	per lb.
Lead: Acetate (Sugar) White, English		27	10	0	per ton.
,, ,, ,, Foreign c.i.f. U.K		24	5	0	,,
,, ,, Grey		21	15	0	,,
,, ,, Brown at Manchester		17	0	0	,,
Nitrate		24	0	0	,,
Litharge, Flake		15	10	0	,,
,, Powder		16	0	0	,,
Red Lead, Genuine, c.i.f. London less 5%		15	10	0	,,
White ,, ,, Dry ,, ,, ,,		16	15	0	,,
Naphtha (Wood): Miscible, 60 o.p.		0	2	10	per gal.
Solvent		0	2	7	,,
Potash: Bichromate... delivered England		0	0	3	per lb.
Carbonate, 90/92 % ... c.i.f Hull		18	0	0	per ton.
Caustic, 75/80 % ...... ,, ,,		20	10	0	,,
Chlorate ....net		0	0	3 1/16	per lb.
Montreal........in Store, Liverpool		35	0	0	per ton.
Prussiate, Yellow ....net		0	0	5	per lb.

		£	s.	d.	
Soda:	Ash, Caustic, 48 %, Ordinary .. net	5	5	0	per ton.
	,, ,, ,, Refined...... ,,	6	5	0	,,
	,, Carbonated, 48 %............ ,,	5	10	0	,,
	,, ,, 58 % (Ammonia Alkali) ....net	4	10	0	,,
	,, Bleachers' Refined Caustic 50/52 % .... net	6	10	0	,,
	Caustic, White, 77 %............... ,,	10	10	0	,,
	,, ,, 70 %............... ,,	9	12	6	,,
	,, ,, 60 %............... ,,	8	12	6	,,
	,, Cream, 60 %............... ,,	8	10	0	,,
	Crystals, in bags	3	0	0	,,
	,, barrels	3	7	6	,,
	Acetate .... c.i.f. Hull net	16	10	0	,,
	Bicarbonate, in 1 cwt. kegs............	6	15	0	,,
	Bichromate......delivered England...	0	0	2¼	per lb.
	Chlorate .... net	0	0	3$\frac{1}{16}$	per lb.
	Nitrate...ex quay Liverpool, ... ,,	11	7	6	per ton.
	Phosphate	9	5	0	,,
	Prussiate ....net	0	0	3⅝	per lb.
	Silicate, Solution, 140° Tw.	4	10	0	per ton.
	Sulphate (Glauber Salts)...............	1	12	6	,,
	,, (Saltcake, 95%)...............	1	15	0	,,
Sulphur:	Recovered	4	15	0	,,
	Roll	6	15	0	,,
	Flowers....................................	7	10	0	,,
Zinc:	Sulphate	6	15	0	,,

MINERALS.

		£	s.	d.	
Barytes:	Lump Carbonate, 90/92%	3	10	0	per ton.
	Sulphate, No. 1, White	2	15	0	,,
China Clay:	of various qualities for all purposes; prices from about 11/- to about 30/- per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid.				
Chrome Ore:	Basis 50% c.i.f. British Ports..........................	3	7	6	,,
Manganese:	Lump c.i.f. Liverpool 10¼d.				per metallic unit.
Ochre:	French JC .... f.o.b. Rouen, net	2	5	0	per ton.
	,, JF.......................................	5	10	0	,,
Talc:	(French Chalk).........c.i.f. Liverpool	3	10	0	,,

OILS, etc.

		£	s.	d.	
Aniline Oil	....................................net	0	0	4¾	per lb.
,, **Salt**	.... ,,	0	0	4½	,,
Castor Oil:	French, 1st pressure, f.o.b. Marseilles less 1½%.........	23	0	0	per ton.
	English, 1st pressure, f.o.r. Hull, less 2½%...............	23	10	0	,,
Cocoa Nut Oil:	Ceylon, ex store Manchester..............net	29	10	0	,,
	Cochin, ex store Manchester . ...net	32	0	0	,,
Cotton Seed Oil:	Refined at Hull, less 2½% naked	13	10	0	,,
	Edible...at Hull, less 2½% naked	14	0	0	,,
Glycerine:	Crude, 80% .... net	31	0	0	,,
Linseed Oil:	Raw... ..at Hull, less 2½% naked	13	12	6	,,
	Boiled......at Hull less 2½% naked	14	12	6	,,
Starch:	American Pearl...at Manchester, net	9	0	0	,,
	Dextrine........... ,, ,,	18	0	0	,,
	Farina............... ,, ,,	15	15	0	,,
Shellac:	Standard TN orange spot	140/-			per cwt.
Turpentine:	American.........at Liverpool	38	10	0	per ton.
	Russian ....at Hull...net	19	0		,,

TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote:—

COLONIAL WOODS.

Timber.

		£	s.	d.		£	s.	d.
Quebec Square White Pine...	per cub. ft.	0	1	9	to	0	3	0
Quebec Waney Board Pine...	,,	0	2	8		0	3	9
St. John Pine, 18 in. average	,,	0	2	4		0	3	3
Lower Ports Pine...............	,,	0	1	3		0	1	8
Quebec Red Pine	,,	0	1	6		0	2	0
Quebec Oak, 1st quality	,,	0	2	9		0	3	4
Quebec Oak, 2nd quality ...	,,	0	1	6		0	2	6
Ash	,,	0	1	6		0	2	3
Elm	,,	0	3	3		0	3	10
Hickory	,,	0	2	0		0	2	6
Quebec Birch	,,	0	1	6		0	2	3
St. John Birch	,,	0	1	6		0	2	0
Birch Planks.....................	,,	0	0	9		0	0	11
Spruce Spars	,,	0	0	10		0	1	0

Deals.

		£	s.	d.		£	s.	d.
1st quality Quebec Pine	per std.	22	10	0	to	32	10	0
2nd do. do.	,,	17	0	0		22	0	0
3rd do. do.	,,	11	10	0		13	0	0
St. John, N.B., etc., Spruce	,,	6	15	0		7	5	0
Lower Ports Spruce...	,,	6	10	0		6	15	0
Spruce Boards................	,,	5	10	0		6	0	0

UNITED STATES, etc., WOODS.

Pitch Pine.

		£	s.	d.		£	s.	d.
Hewn	per cub. ft.	0	1	4	to	0	1	8
Sawn	,,	0	0	11		0	1	6
Planks, Stowage	,,	0	0	10		0	1	0
Boards, Prime	per std.	12	10	0		16	0	0
Oak Timber	per cub. ft.	0	1	6		0	2	6
Oak Planks	,,	0	1	6		0	2	1
East India Teak...............	per load	12	0	0		16	0	0
Greenheart......	,,	6	15	0		7	10	0

EUROPEAN WOODS.

Timber.

		£	s.	d.		£	s.	d.
Riga Redwood	per cub. ft.	0	1	6	to	0	2	0
Dantzic and Memel Fir, Crown	,,	0	2	1		0	2	6
Dantzic and Memel Fir, Middling	,,	0	1	9		0	1	11
Stettin	,,	0	1	9		0	1	11
Swedish..........................	,,	0	1	0		0	1	3
Riga Whitewood	,,	0	1	0		0	1	3
Norway Mining Timber	,,	0	0	9		0	1	0
Dantzic and Stettin, etc., Oak...	,,	0	2	6		0	3	0
Norway Spars.................	,,	0	1	2		0	1	9

Deals.

		£	s.	d.		£	s.	d.
Red Archangel and Onega, 1st quality	per std.	19	0	0		20	0	0
Red Archangel and Onega, 2nd quality	,,	14	0	0		16	0	0
Red Archangel and Onega, 3rd quality	,,	10	10	0		12	10	0
St. Petersburg, 1st quality...	,,	16	0	0		17	10	0
Do. 2nd ,, ...	,,	14	0	0		15	0	0
Gefle	,,	11	10	0		16	0	0
Wyburg	,,	11	0	0		12	10	0
Uleaborg	,,	10	0	0		12	10	0
Gothenburg	,,	11	0	0		16	0	0

SELECTED PATENTS.

Compiled expressly for this journal by **Messrs. Page and Rowlingson, Engineering Patent Agents, 28, New Bridge Street, London, E.C.,** and at Manchester.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton Buildings, Chancery Lane, W.C., at the uniform price of 8d.

NEW PATENTS APPLIED FOR.

When Patents have been communicated the names of the communicators are printed in italics.

2270. E. K. Ansorge, Kingston-on-Thames. Feb. 6th.—An improved ratchet wrench.

2275. R. C. Livesey, Manchester. Feb. 6th.—Improvements in warping machines.

2282. J. Meikle, London. Feb. 6th.—Self-indicating automatic lubricator.

2290. W. H. A. Robertson, Birmingham. Feb. 6th.—An improved tubular boiler for motor carriages, wagons, and other suitable purposes.

2293. A. Jack, Renfrewshire. Feb. 6th.—Reversing and controlling rotation in internal combustion engines.

2312. L. W. Hancock, London. Feb. 6th.—Improvements in wrenches.

2314. M. F. Christensen, London. Feb. 6th.—Machine for making rounded bodies.

2318. A. G. Taylor, London. Feb. 6th.—An improved adjustable spanner.

2329. A. J. Boult, London. Feb 6th.—Improvements in or relating to rotary engines. (*M. B. Mills, U.S.A.*).

2340. J. Hussey, London. Feb. 6th.—Improvements in float valves, and draw-off and other cocks and taps.

2356. F. W. Flint and C. M. Gates, London. Feb. 6th.—Improvements in steam turbines or rotary engines.

2366. R. H. Rice, London. Feb. 6th.—Improvements in governing mechanisms for elastic fluid turbines. (Date applied for, Feb. 6th, 1904.)

2388. R. C. Pessell and R. Ord, Birmingham. Feb. 7th.—Improvements in the mode of and means for governing the speed of oil engines.

2400. H. E. Francis, London. Feb. 7th.—Diving torpedo-boat.

2408. A. E. Shute, Glasgow. Feb. 7th.—Improvements in vertical boilers.

2411. J. H. Gault, London. Feb. 7th.—Method of producing seamless hollow metallic vessels.

2415. F. G. Heath, Birmingham. Feb. 7th.—A new or improved swivel joint.

2431. D. Black and W. W. Black, London. Feb. 7th.—Improvements in drills or bits for drilling holes in rock and the like.

2437. W. H. Couling, Devon. Feb. 7th.—An improved method of variable speed gearing for machinery.

2439. L. D. Lovekin, London. Feb. 7th.—Improvements in machines for expanding and flanging metal pipe.

2442. E. A. Munn, London. Feb. 7th.—Improvements in gate or valve mechanism for grain hoppers, chutes and the like. (Date applied for May 21st, 1904.)

2459. P. Redford, Manchester. Feb. 7th.—Improvements in metallic packings.

2476. N. Lombard, London. Feb. 7th.—Improvements in governors.

2478. G. H. Truxell and L. M. Burget, London. Feb. 7th.—Improvements in concrete wall forming machines.

2486. L. Nussbaum, London.—Device for automatically securing miners' trucks in their cage.

2487. E. Peckham, London. Feb. 7th.—Improvements relating to axle journal boxes.

2489. E. Peckham, London. Feb. 7th.—Improvements in axle lubricators.

2500. J. L. Rushton, Manchester. Feb. 8th.—Improvements in bearings for rotating shafts, particularly for the tin roller shafts of spinning and like machines.

2516. A. Hitchon, E. Hitchon, J. R. Hitchon and Hitchon Gear and Automobile Company, Ltd., Accrington. Feb. 8th—Improved induction valve for internal combustion engines.

2522. C. J. Montgomery, and W. Prescott, Liverpool. Feb. 8th.—Improvements in means for locking nuts in any required position on a bolt stud or other screw.

2525. D. Deas, and A. Deas, Glasgow. Feb. 8th.—Improvements in rotary engines.

2533. J. E. Schmidt, Kidderminster. Feb. 8th.—An electric high and low water level indicator for water tube boilers.

2538. A. Robertson, London. Feb. 8th.—Auxiliary tools for turning lathes.

2548. B. Mitchell, London. Feb. 8th.—Improvements in steam boilers.

2550. W. Badger, Junr., London. Feb. 8th.—Improvements in and relating to sprocket wheels.

2568. R. F. Yorke, Stirling. Feb. 8th.—Improvements in steam generators.

2571. F. E. Smith, and C. T. Russell, London. Feb. 8th.—Improvements in slide valve mechanisms for steam engines.

2614. R. H. Wood, Southport. Feb. 9th.—A patent guard for turning lathes.

2618. J. Riley, Stockton-on-Tees. Feb. 9th.—An improved water-tube vertical boiler.

2620. W. Baldwin, Blackburn. Feb. 9th.—Improvements in or relating to stop valves for steam or other purposes.

2625. A. Lefebvre, Manchester. Feb. 9th.—Pneumatic tools or devices for grinding or polishing valves on their seats and for other purposes.

2630. H. Begg, Junr., London. Feb. 9th.—Improvements in angle iron and other metallic bars.

2636. A. W. Lawder, and M. N. Ridley, London. Feb. 9th.—Improvements in or relating to ventilating valves, sluice traps, or other similar apparatus.

2650. W. H Heeson, London. Feb. 9th.—Improvements in the construction of boiler furnaces.

2657. J. Smith, Surrey. Feb. 9th.—Improvements in and relating to the superheating of steam or steam engines.

2667. J. F. Jones, London. Feb. 9th.—Improvements in spanners, wrenches, pipe-grips, and the like.

2745. The Taynge Tool and Electric Co., Ltd., and C. Pendlebury, London. Feb. 10th.—Improvements in change gearing for lathes and other machine tools, motor-cars, and machinery in general.

2754. F. E. Jordan, London. Feb. 10th.—Improvements in superheaters for smoke prevention and improving combustion, as applied to steam boilers, furnaces, and the like.

2755. T. W. Hill, London. Feb. 10th.—Improvements in and relating to belts for the transmission of power.

2758. T. E. Clarke, London. Feb. 10th.—Automatic coupling.

2781. F. P. Hummel, London. Feb. 10th.—Improvements in instantaneous steam generators.

2795. G. Mitchell, London. Feb. 10th.—Improvements in apparatus for generating steam from hot slag.

2796. D. Morell, London. Feb. 10th.—Improvements in and connected with packing discs for rotary engines.

2799. O. Briede, London. Feb. 10th.—Improvements in or relating to Pilger rolling mills.

2825. W. G. Crossthwaite, Leeds. Feb. 11th.—Improvements in or relating to furnaces.

2827. H. J. Brashier, London. Feb. 11th.—Improvements in or relating to ball or float valves for water cis

2843. T. Bamforth and A. Robert
11th.—Improvements in machines for mouldin
scuttles.

2847. J. Watts, Cheshire. Feb. 11th.—Improvements in clay excavators for digging clay automatically.

2851. Fried. Krupp Aktiengesellschaft, London. Feb. 11th.—Improvements in and means for cooling crank pins and shafts. (Date applied for March 19th, 1904.)

2861. A. J. Boult, London. Feb. 11th.—Improvements in or relating to the treatment of lead and like ores. (*La Société Anonyme des Mines de Bormettes and Alfredo Lotti, France.*)

2876. A. Chambolle, London. Feb. 11.—Improvements in cocks for water gas and other mains. (Date applied for April 9th, 1904.)

RECENT SPECIFICATIONS.

LIQUID FUEL BURNERS.

Sir W. G. Armstrong, Whitworth and Co., Ltd., E. L. Orde, and W. H. Sodeau, of Newcastle-on-Tyne. Feb. 8th, 1904.—The object of this invention is to effect improvements in burners for petroleum or other liquid fuel, whereby such burners may be adapted to secure, when necessary, the smokeless combustion of the largest possible quantity of liquid fuel in a given cubic space of furnace, and this is accomplished by such a disposition and proportioning of the various parts of the burner as to bring about the intimate admixture of an appropriate amount of air with sprayed petroleum or other liquid fuel, before it leaves the outlet of the burner and becomes ignited, and in giving to the issuing flame such velocity of outflow as prevents it from lighting back within the burner and enables it to traverse the furnace space in spite of any cross currents of air supplied, for the purpose of completing combustion, to the outside of the flame. The apparatus employed consists of a mixing tube placed entirely or mainly outside the furnace-space and arranged so as to provide in the form of an induced current a quantity of air equal to not less than about four times the weight of oil in the spray for mixing with the oil spray prior to ignition, the said mixing tube being shaped so as to confine the air and the spray and proportioned so as to secure the intimate admixture of the two before ignition, such proportioning involving the continuation of the mixing tube to a point considerably beyond the suction plate.

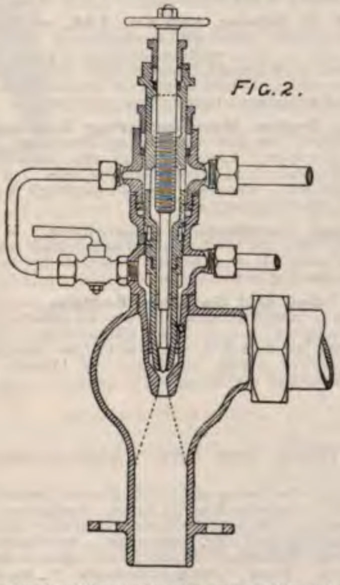
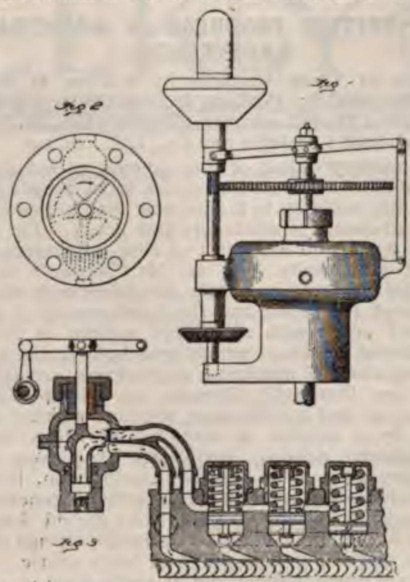


FIG. 2.

ELASTIC FLUID TURBINES.

James Wilkinson, of Alabama, U.S.A. Jan. 4th, 1904. (Date claimed under the International Convention).—The invention relates to an improved governing mechanism for elastic fluid turbines, wherein a number of motor-fluid valves are controlled and successively actuated by a body of fluid subjected to pressure created by impact, and regulated in a controller passage by the injector action of a stream of fluid under the control of a governor-shifted nozzle, the position of which relatively to said passage determines the potential of the static pressure therein. To produce a constant speed of rotation under varying loads by this governing mechanism, an intermittent rising and lowering of the pressure of the controller, fluid is provided sufficient to pulsate the valve or valves nearest the critical point of regulation in order to compensate variations in load between stated points of economy represented by the several nozzles and of a value corresponding to their horse-power capacity. If there be no wire-drawing action of the turbine valves, it is not possible for the governing devices now in use when the nozzles are of fixed proportions to maintain a constant speed of shaft rotation, since they will have no movement whose controlling effect is capable of compensating variations in load between the stated points of economy under its control. By intermittently opening the valve at the critical point of regulation for intervals of varying duration all load variations intermediate of the points of economy may be compensated. This is effected by rotating the controller nozzle or oscillating it, so that the impact pressure of the fluid stream in the controller passage will be effected.



PUMPS.

C. Day and W. A. Dexter, of the Mirrlees-Watson Co., Ltd., of Glasgow. Dec. 15th, 1904.—This invention relates to pumps working in connection with steam condensers of either surface or jet type, and used for extracting water from the condensers, and it more especially applies where the air and water are extracted from the condenser by separate pumps. The object is to secure a more efficient extraction of the water from the condenser. To attain this object it is proposed to control the admittance of the water to the pump by a mechanically operated slide valve or valves; the discharge of the water from the pumps may be controlled by the same valve as controls the suction, or by an ordinary valve opened by the pressure of the water. In this invention it is arranged that the valve which controls the entrance of the water to the pump is mechanically opened, thus securing an uninterrupted passage of water from the condenser to the pump throughout each suction stroke of the pump, thus giving a minimum of resistance to the entrance of the water to the pump, and a maximum voluntary displacement, the valve being arranged to open immediately on commencement of the suction stroke, and close immediately on the completion of this stroke; there is no water slips back past the valve and the full quantity is discharged through the discharge ports; this discharge port may be controlled either by the same valve or by any other form of valve desired.

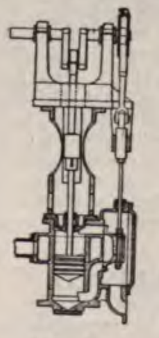


FIG. 1.

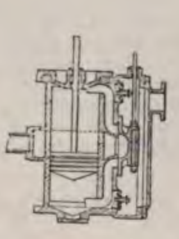


FIG. 2.

NEW PUBLICATIONS.

"BRITISH PROGRESS IN MUNICIPAL ENGINEERING."

A series of Three Lectures by William H. Maxwell, A.M.Inst.C.E. (Volume I. of the National Engineering and Trade Lectures. Edited by Ben. H. Morgan.) Archibald Constable and Co., Ltd. 6s. net.

The primary object of this scheme of lectures is to show colonial and foreign buyers what progress Great Britain has made up to the present time in the manufacture of all classes of machinery and goods. The present volume deals with a subject of vital importance to the general community, for, as Mr. Maxwell remarks, municipal progress is largely coincident with the social progress of the people and the developments of science. The work opens with a succinct account of the rapid succession of advances which have built up the present-day programme of municipal engineering practice; the writer then thoroughly discusses the principles of road engineering and maintenance, a lecture which is accompanied by a number of sectional drawings showing constructional details; particulars are given of the machinery utilised in roadway construction, including steam road rollers, road surface scarifiers, stonebreakers and roadedge paring plant. The second lecture is devoted to sewerage and main drainage, sewage disposal and the disposal of domestic and trade refuse; special attention is given to the bacterial purification of sewage and the disposal of refuse by fire. Probably the most important section of the book is that dealing with water supply. The writer details the various schemes planned by the leading municipalities, and indicates the great progress made in the design and economy of pumping machinery in this branch of engineering activity. Following each section is a classified list of British manufacturers interested in the particular sphere of industry covered by the preceding lecture. Those anxious to make a special study of this subject will find the list of municipal engineering literature given in the appendix of considerable service.

"THE UNIVERSAL ELECTRICAL DIRECTORY, 1905."

Containing a complete record of all the industries directly or indirectly connected with electricity and magnetism. H. Alabaster, Gatehouse and Co. 14s.

This invaluable compilation has now reached its twenty-fourth year of publication; among many other important features it contains the names and addresses of members of the electrical and allied trades and professions throughout the world. The directory is divided into four sections: British, Colonial, U.S.A., and Continental; each of these sections is again divided into alphabetical and classified divisions, and in the case of the British, a geographical section is also included. We have submitted the volume to a number of severe tests, each time with satisfactory results. The work of revision has been thoroughly carried out, and all the information contained in the volume appears to have been brought up to date.

BOOKS RECEIVED.

Mechanical Appliances, Mechanical Movements and Novelties of Construction. By Gardiner D. Hiscox, M.E. Second Series. Archibald Constable. 12s. 6d. net.

The Elements of Railway Economics. By W. M. Acworth. Clarendon Press. 2s. net.

The Oil Mills Directory, 1905-6. Second Edition. Simpkin, Marshall, Hamilton, Kent and Co., Ltd. 2s. 6d. net.

Engineering Drawing and Design. By S. H. Wells. Part I. Practical Geometry. Part II., Machine Drawing. 4s. 6d. each.

NEW CATALOGUES.

Messrs. J. Parkinson and Son, of Canal Ironworks, Shipley Yorkshire, have issued an attractive little booklet entitled "About Vises." This is arranged in the form of short paragraphs, points of special interest being rendered in heavy black lettering, while the cross heads are printed in red. Several illustrations and two pages for memoranda are included.

The subject of List No. 70 (January, 1905), issued by Messrs. Holden and Brooke, Ltd., of Sirius Works, West Gorton, Manchester, is Brooke's Patent Injectors, of which many illustrations and diagrams are included. Some useful information is given on "How to select the right size of Injector," together with a number of tables.

From Messrs. Boot and Son, Ltd., Printers and Stationers, of 32, Fleet Street, E.C., we have received an illustrated calendar for February, a copy of Boot's Memo. Tablet, and a circular dealing with "Slit-Leaf" Duplicate Post-Card Books, which appear to be a valuable business auxiliary.

Messrs. J. S. Fairfax and Co., of 37 and 39, Essex Street, Strand, W.C., forward their List No. 1. (Direct Driving from High-Speed Shafts at Low Speeds) of Fairfax's Patents—Reduction and Speed-varying Gear, for driving direct from armature or engine shafts at standard ratios: Variable Speed Pulley Shafts: Compound Bearings for Reducing or increasing Speed: Hoisting and Winding Gear. Each different type is described and illustrated with the aid of tables and line drawings.

Messrs. W. T. Glover, and Co., Ltd., of Manchester, send a price list of rubber cables with discount sheet. The catalogue last issued remains in force without alteration of prices in any way, for diatrine paper lead covered cables, diatrine paper "leadless" cables, and Bitumen cables. Details are given of the new "Non-Association" cables, which are referred to elsewhere in this issue.

From The Begbie Manufacturing Company, of 407, Oxford Street, W., we have received an illustrated catalogue and price list of "Aster" engines, gears and coils; Longuemare Carburetters; Begbie-Audin Radiators; back and front axles; pumps; lubricators; Chassis; Begbie-Lamplough steering gears; Begbie-Oleo sparking plugs, etc.

"Mechanical Ventilation Specialities" is the title of Messrs. John Gibbs and Son's new catalogue, which we note cancels all previous issues. It describes and illustrates the firm's improved patent air propelling and ventilating fans.

The "Gus" Gas and Gasoline Engines are illustrated and described in a pamphlet issued by the manufacturers, The Carl Anderson Company, of 23-27, North Clinton-street, Chicago, U.S.A., of which firm Mr. Eric S. A. Smith is English representative. We have also received leaflets illustrating the 'Dandy" back-geared pumping jack, and the improved "Oriole" compressed tablet machine.

MEETINGS FOR THE ENSUING WEEK.

FRIDAY, FEB. 24.—Institution of Civil Engineers, Great George Street, S.W.: Student's Meeting, 8 p.m.—Institution of Electrical Engineers (Manchester Local Section): 7.30 p.m., Paper, "Metallography," Mr. Buttenshaw.—Manchester Motor Show Opens.—Edinburgh Motor Show Opens.—Royal Society, 9 p.m.: Paper, "Fungi," Professor H. Marshall Ward.—Physical Society.—Electro-Harmonic Smoker, Holborn Restaurant, Ladies' Night.—Rugby Engineering Society, 8 p.m.: Lecture, "The Minute Structure of Metals," Mr. J. T. Milton.

SATURDAY, FEB. 25.—Royal Institution, 3 p.m.—Manchester Association of Engineers, 7 p.m.: Paper, "Pig Irons and their use in Foundry and Forge," Mr. E. Adamson.

MONDAY, FEB. 27.—Institute of Marine Engineers, Stratford, 8 p.m.—Association of Technical Institutions: Annual General Meeting, School of Technology, Manchester.—Society of Arts: Cantor Lecture, "Internal Combustion Engines," Mr. Dugald Clerk.—Institution of Electrical Engineers (Newcastle Local Section).

TUESDAY, FEB. 28.—Society of Arts (Colonial Section).—The University of Liverpool Engineering Society, 5.30 p.m.: Paper, "The Mechanics of a Plant Skeleton," Professor R. J. Harvey Gibson.—Royal Institution, 5 p.m.

WEDNESDAY, MAR. 1.—Society of Arts: Ordinary Meeting, "British Art Section of St. Louis Exhibition," Mr. Isidore Spielmann.

THURSDAY, MAR. 2.—Chemical Society, 8 p.m.—Dundee Institution of Engineers: Paper, "The Motor-Car of To-day," Mr. A. Morris Thomson.—Royal Institution: Paper, "Recent Astronomical Progress," Professor H. H. Turner.—Royal Society, 4.30 p.m. Institution of Civil and Mechanical Engineers, 8 p.m.

FRIDAY, MAR. 3.—Royal Society, 9 p.m.: Lecture, Mr. G. Marconi "Recent Advances in Wireless Telegraphy."—Liverpool Motor Show opens.

PAGE'S WEEKLY

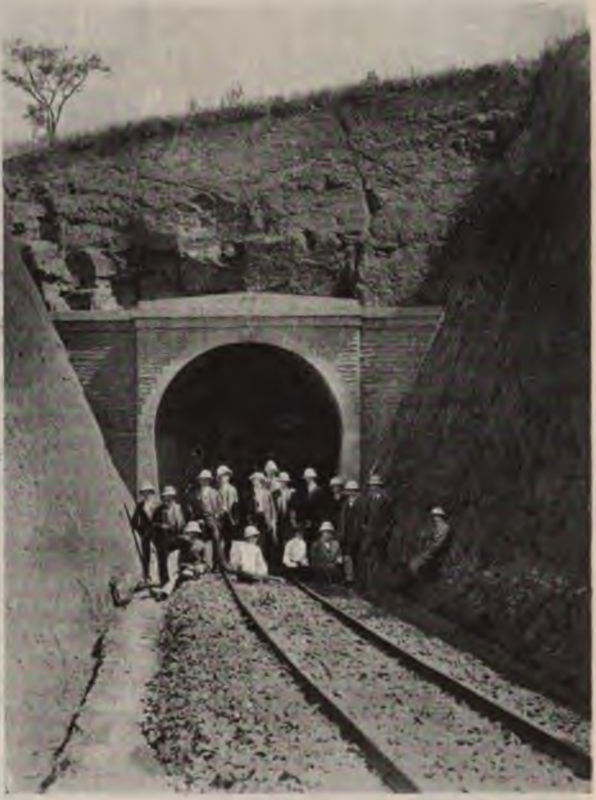
An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

VOL. VI. LONDON, FRIDAY, MARCH 3, 1905. No. 25.

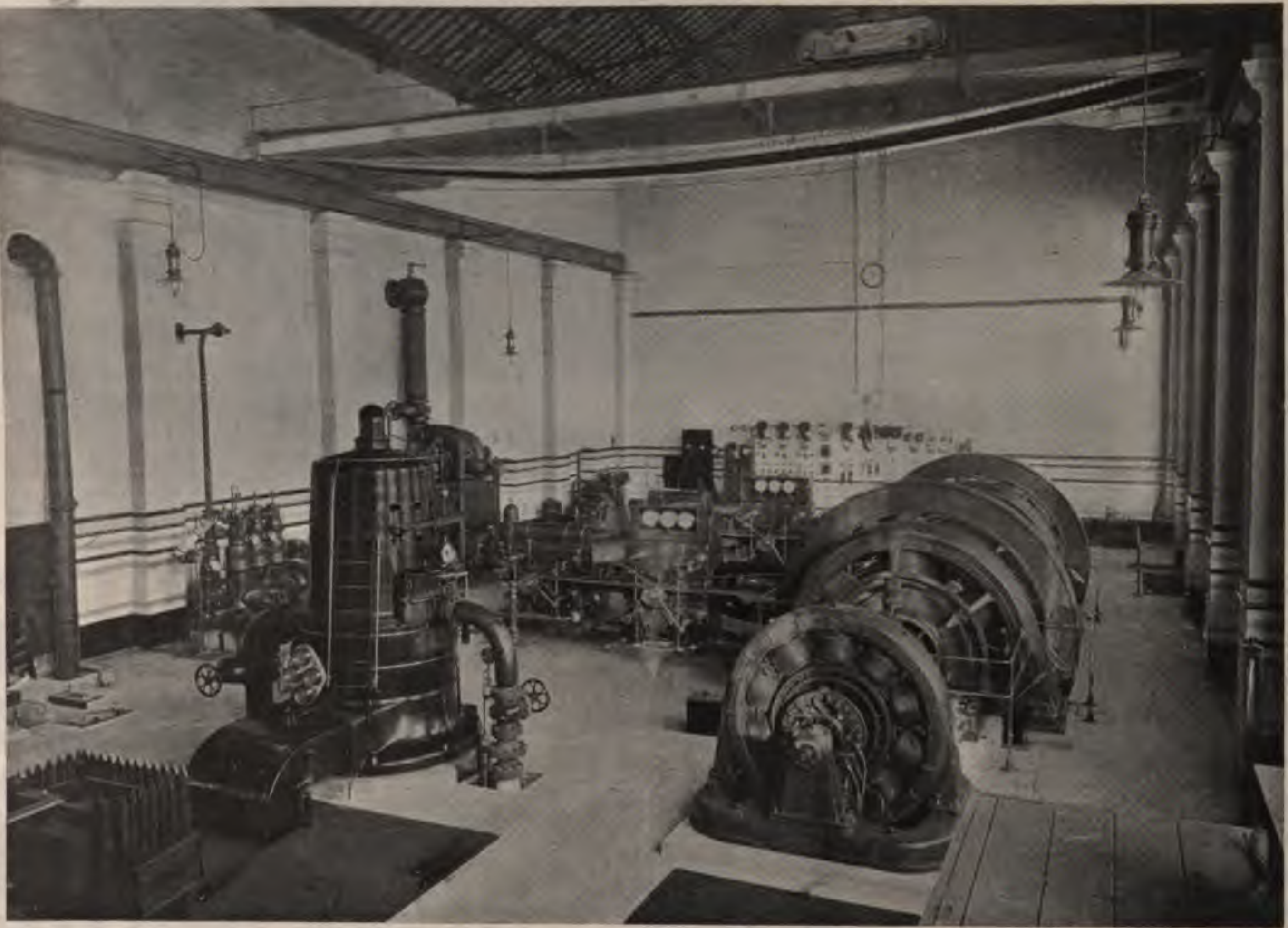
The Offices of "Page's Weekly," Wednesday, Midnight.

A REPORT on the Uganda Railway recently presented to Parliament makes interesting reading in conjunction with the article on that enterprise which appears elsewhere in this issue. It covers the construction and working of the railway and steamboat service on Lake Victoria during 1903–1904, and is of a very encouraging nature. During the first half of the year under review, the railway was under the control of the committee appointed to supervise its construction, but on October 1st, 1903, it was made over to the Protectorate, placed in charge of a manager specially selected by the Secretary of State, and became an integral part of the East African Administration. The report shows that the whole of the line, with the exception of a short length round the tunnel (mile 526) is now on the permanent formation. Embankments which had settled down owing to rain, and cuttings not previously of full width have been brought to the standard section. Owing to the repatriation of trained Indian labourers and to the employment in their places of Africans, progress with the tunnel was much slower than had been anticipated, but the difficult portion of the work was completed by the end of the year under review, and the tunnel was opened for public traffic on September 21st. This is complete with the exception of the replacement of timber by masonry abutments in the case of a few small girder openings.

All portions of the line urgently needing ballast have been attended to and at least partially ballasted. It will, however, take a



THE UGANDA RAILWAY.
Entrance to the tunnel at mile 526.



RECENT TURBINE INSTALLATIONS (III.)—A CURTIS TURBO-GENERATOR ERECTED IN THE POWER HOUSE OF THE BRITISH THOMSON-HOUSTON COMPANY, LTD., AT RUGBY.

The capacity of this unit is 500 k.w., the speed being 800 r.p.m., and voltage 2,300. It is interesting to note that the capacity of the small turbo-generator is equal to the combined capacity of the reciprocating sets, which are also shown in the above view. The reciprocating sets consist of two 200 k.w. generators driven by Cole, Marchant and Morley engines, operating at 120 r.p.m., and one 100 k.w. generator driven by a Browett and Lindley engine, operating at 235 r.p.m. The normal steam pressure of the various units is 150 lb. per square inch. The British Thomson-Houston Company are the sole manufacturers of the Curtis Turbine in this country.

considerable time to bring the ballast over the whole line up to full section, but this is being done as local labour becomes available. A considerable number of wooden sleepers laid in the first section, under the supposition that salt in the soil would destroy metal ones, have become useless owing to dry rot, and are being replaced by steel, which is now found to be suitable. Experiments with local timber are being made to test its value for sleepers. Goods sheds have been erected at stations needing this accommodation, and all locomotives, carriages, and wagons used in construction work are being thoroughly overhauled and put in good working order. The following table shows the number of labourers of all kinds employed on the construction of the railway at the end of the year under review :—

Locally engaged (Africans)... ...	3,660
Indentured Indian artisans	216
Indentured Indian coolies	521
Total	4,397

The health returns are about normal for the climate.

From the report on the North Sea outrage it is apparent that wireless telegraphy in war, unless handled with discretion, may be more potent as a destructive agent than submarine mines. "Attacked on all sides by torpedo boats" was the unfounded message sent on by the captain of the unfortunate *Kamchatka* to his already scared chief. After this, only a fisherman's rocket was needed to cause what practically amounted to a panic. There have since been panics at home. Only a few days ago when the garbled report of the Commission's findings was wired over we actually saw in one London daily paper the legend, "Death-blow to Arbitration!" As regards the North Sea outrage, at any rate, arbitration has been conspicuously successful.

We call attention, in another column, to a notable development in power production. A useful survey of the various gas producers which claim consideration for power purposes has just been completed by Mr. W. H. Tookey. The work, which is published by Messrs. Percival Marshall and Co., does not profess to deal to any extent with technicalities, but it is a valuable work to have on hand if only for the sake of its numerous line drawings, its plain talks affecting coal-bills, and its hints for attendants. The author remarks that in moderate-sized gas producers, even from 20 h.p., enough gas can easily be obtained from 1 lb. of anthracite coal, in every-day work, to develop 1 i.h.p. in a gas-engine cylinder under full load conditions. This shows a saving of 33⅓ per cent. In the majority of factories the actual saving is more than 50 per cent. As a practical example, he quotes the experience of a Suffolk firm of brewers, who have installed a gas-producing plant to serve a 10 b.h.p. gas engine. The engine is at work for about eight hours each day, during which time the load is constantly varying with the number of machines that are thrown in and out of work, as is common to all factories. They tell the firm of engineers responsible for the installation, that only 56 lb. of anthracite has to be fed into the generator during the whole of the day. They buy their fuel for 20s. per ton, and therefore run the whole of their machinery for 6d. per day.

Another example is cited in connection with a London plant. A firm of engineers have installed a gas (suction) producer to serve a gas-engine of 18 b.h.p. They find that the weekly coal bill amounts to 6s. per week. (They formerly paid 28s. per week for town gas for the same load.) Other practical examples cited are the electric generating stations at Walthamstow, London, and Norwich. According to the electrical engineer's report for the twelve months ending March 31st, 1903, the Walthamstow station generated a total of 659,776 Board of Trade units, on an average fuel consumption of 2 lb. per unit generated. After taking into consideration the cost of fuel, oil, waste, wages for generation, repairs and maintenance of gas plant, engines and electrical plant, the works' cost per unit generated amounted to 0·89d.

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At Northwich, Mond producers are used, or rather Mond gas is purchaseed from an adjoining factory at the rate of 2d. per 1,000 cubic feet. The station during the year 1901–2 sold 88,777 units, and the fuel cost was 0·47d. per unit sold. From a table published in the Electrical Times, December 4th, 1902, it would appear that the fuel costs, striking an average from the results published by 167 public electric light stations using steam power, was 0·952d. per unit sold, varying from 3·65d. to 0·71d. The question of stand-by losses should be taken into account when comparing gas engines and producers with steam engines and boilers.

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The tendency towards specialisation in all lines of manufacture involves another and no less important risk to the worker, and is coincident with the decline of the all-round skilled mechanic. "Young men who enter American shops to-day," says Mr. Outerbridge, in the paper we quoted last week, "find employment in tending special machines, and soon become highly trained in their operation, so that they earn large wages, consequent, of course, upon their ability to turn out, by the aid of these machines, the maximum amount of work with a minimum of defects. They are encouraged by their employers to continue at one job, and feel little ambition to change to another class of work, or to another kind of machine, where their experience avails but little. Thus we have skilled planer hands who know nothing about the operation of lathes, milling machines, or other mechanical appliances in the same shops. The Baldwin Locomotive Works, the largest of the kind in the world, and the most highly developed in specialisation of manufacture, have already experienced the difficulty of finding young men competent to take the place of older hands, and have shown wise forethought in establishing a new school of apprentices, with a general superintendent in charge, and a staff of supervisors or foremen of apprentices."

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According to the official itinerary for the South African British Association, which has been provisionally fixed, the party will leave Southampton on Saturday, July 29th. The association will assemble at Capetown on August 15th, when Professor G. H. Darwin, the president elect, will deliver his address.

THE S.S. "PORT MARIA."

The first vessel to leave London for Bermuda, Turks' Island, and Jamaica in connection with the new line of the Imperial Direct West Indies Mail Service Company, Ltd. The inauguration of the new service was recently celebrated at a dinner in London given by Sir Alfred Jones.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

DAVIDGE PAGE, Editor.

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Telegraphic and Cable Address: "SINEWY, LONDON."

Editorial.—*All communications intended for publication should be written on one side of the paper only, and addressed to "The Editor."*

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New Copy for Advertisements,

Alterations, &c., intended for insertion in the current week's issue must be delivered **not later than 4 p.m. on Monday.** If proofs are required the copy and blocks should reach us several days earlier.

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NEWS ITEMS.

The first motor steam fire-engine built to the order of the L.C.C. by Messrs. Merryweather, has just been put into service. It delivers 500 gallons per minute.

Details of the Royal Society Show at Park Royal, commencing on June 27th, are now obtainable from the secretary, at 13, Hanover Square, W.

Professor J. O. Arnold, of the Metallurgical Department, Sheffield University College, has been awarded the Bessemer gold medal of the Iron and Steel Institute. The honour was conferred by the council at its meeting on the 22nd ult.

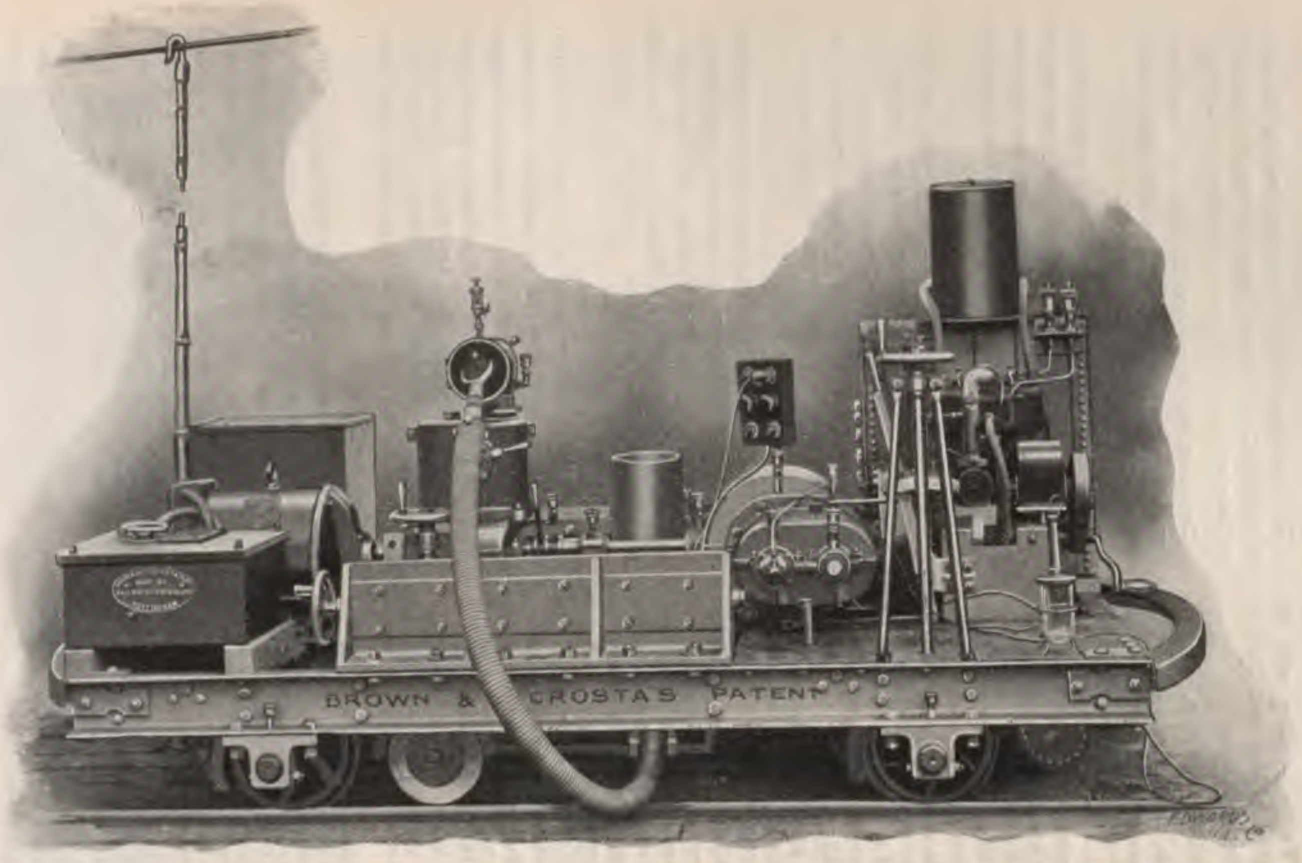
The King has been pleased to appoint the Hon. Alfred Erskine Gathorne-Hardy to be a Commissioner under "The Railway and Canal Traffic Act, 1888," in the room of Viscount Cobham, resigned. Mr. Gathorne-Hardy will also act as chairman of the Light Railways Commission.

At the opening of the 45th annual meeting of the Association of Chambers of Commerce, on Tuesday, the president, Sir William Holland, M.P., was able to refer to trade conditions of a distinctly more favourable nature, on the whole, than have obtained for a long time past.

With regard to the question of the establishment of a Ministry of Commerce, he said that the matter having been named in the King's Speech, the Government were now bound to take action in regard to it. The president thought the Association would agree that if the establishment of a Ministry of Commerce meant nothing but a change of name they could anticipate no real gain.

The Commercial Committee of Members of Parliament had met and had appointed a sub-committee to provide suggestions. He did not know what policy they would adopt, but he personally favoured the formation of a Ministry of Commerce as well as the appointment of a Minister, and he would make the Commercial Intelligence Committee a nucleus of the Ministry of Commerce.

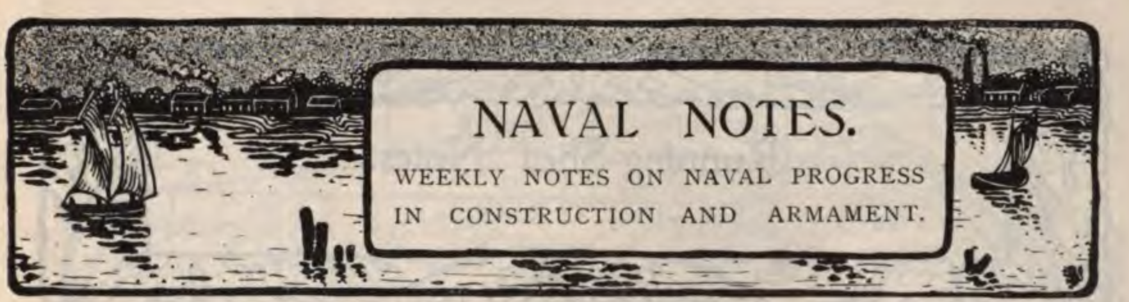
At this meeting it was decided to recommend that the improvement and extension of the canal system of the United Kingdom should be carried out by means of a public trust, and, if necessary, in combination with local or district public trusts and aided by a Government guarantee; and that the executive council be requested to take all reasonable measures to secure early legislation upon the subject.



TRAMWAY RAIL GRINDER SUPPLIED TO HALIFAX CORPORATION BY THE RAILWAY AND GENERAL ENGINEERING COMPANY, LTD., NOTTINGHAM.

This machine is the joint invention of Mr. Arthur Brown, the City Engineer of Nottingham, and Mr. L. W. Crosta, the managing director of the above company. As the joints become worn with the constant striking and hammering of the wheels, corrugations are formed near the joint, causing the cars to jerk at these points. The worn ends of the rails are wedged up, welded together by the patent Thermit process, and the upper surface then ground flush with the rest of the rail. On curves the grinder has been adapted to grind away the worn-out rail in such a way that the guard rail may be fitted to it, and yet remain flush with the surface of the track.

The grinder is fitted with an electric motor so that it can travel and work from the overhead wire. It is also fitted with a 12-h.p.



NAVAL NOTES.

WEEKLY NOTES ON NAVAL PROGRESS IN CONSTRUCTION AND ARMAMENT.

(BY OUR NAVAL CORRESPONDENT.)

GREAT BRITAIN.

THE Navy Estimates have been laid on the table of the House of Commons and will be published before these notes appear. Speculation upon their provisions is therefore unnecessary, but it may be advisable to point out that last year's programme has undergone some little modification of which note must be taken in considering the new proposals. The two battleships of the *Lord Nelson* class have been given out to contract, and work on them is proceeding steadily. Three of the four armoured cruisers asked for by Lord Selborne have been commenced, the *Defence* having been laid down only last week at Pembroke. The fourth vessel, the *Orion*, is apparently not to be proceeded with, and the projected construction of fourteen torpedo-boat destroyers has been also abandoned. Of the fourteen destroyers of the previous programme only the *Garry*, the *Nith*, and the *Swale* remain to be launched. The *Colne* took the water at Chiswick on February 21st.

FRANCE.

It is now as certain as anything well can be that the French Government are about to embark upon the construction of a large number of vessels, and the programme is to cover twelve years, with an annual expenditure of some £4,000,000 for construction. The ex-Minister of Marine has been very severely taken to task in the discussions in the Chamber, and Admiral Bienaimé, in particular, directed a very strong attack upon naval administration under M. Pelletan. M. Thomson, his successor, appears to have the confidence of the Cabinet, and the Chamber has heartily supported his proposal for the new building programme. Work on the *Edgar-Quinet*, at Brest, has been suspended, it being M. Thomson's desire to build homogeneous vessels and not isolated specimens of different naval architect's ideas.

RUSSIA.

The Russian Naval Budget for 1905 totals 116,500,000 roubles (£12,135,415), of which 39,000,000 roubles (£4,062,500) is to be devoted to new construction. The majority of the new vessels which are to be put in hand will be built in Russian yards, but negotiations have been proceeding with the Bethlehem Steel Company of the United States with a view to placing with them ten vessels, either battleships or armoured cruisers. It may be remembered that the *Retvisan* was an American-built ship.

UNITED STATES.

In the struggle between the President and the Senate there is a danger that the American naval programme may suffer. Although the House of Representatives has passed the Appropriation Bill, authorising an expenditure of $99,914,359 (£19,982,871), and the construction of two battleships, it seems quite possible that the Senate may refuse to endorse this Bill, and at least one battleship is expected to be cut out, together with some smaller items. At the present moment there are thirteen battleships, ten armoured cruisers, five protected cruisers, two gunboats and five destroyers under construction for the United States. The aggregate contract price for the hulls and machinery of these vessels is some nineteen millions sterling, and the contract dates of completion extend from the present up to February, 1908. The completion of the torpedo craft has been very seriously delayed, and most of them should have been in commission four years ago.

JAPAN.

To the Japanese programme outlined in my notes on February 10th, it is to be added that the number of destroyers to be put in hand is twenty-five. Of these fifteen will be built in Government yards, and ten by private contractors.

Running-Shed Notes.

V.—By J. C. R. Adams.

(*Continued from page* 427.)

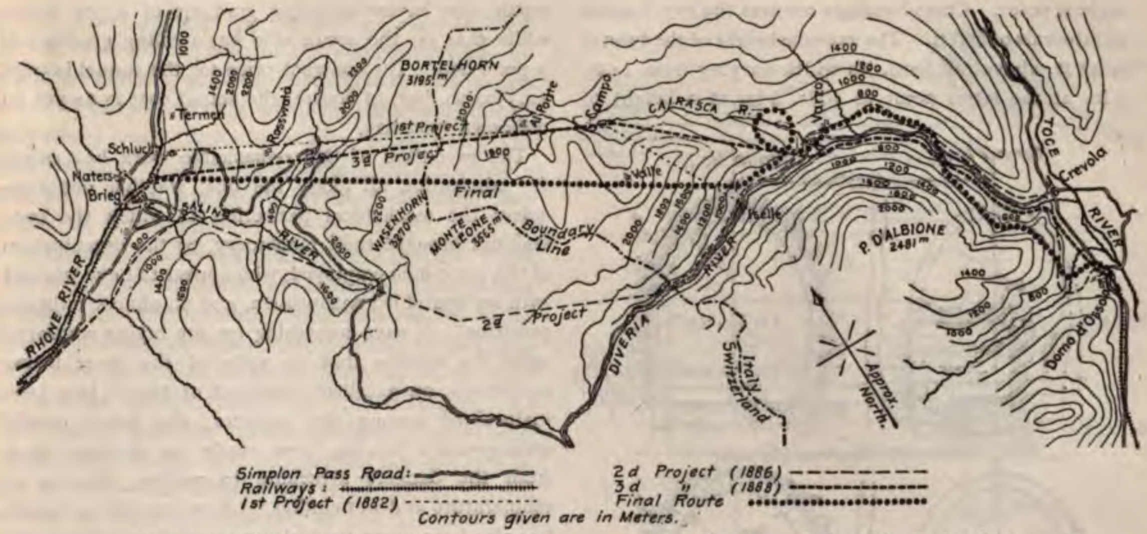
THE governor itself will also need a little attention. Without going into theory, I will deal with the question from the point of view of the engine runner, the man who has to adjust the governor so that it is stable without being sluggish, and sensitive without being unsteady.

In any spring-loaded centrifugal governor, whether its function be to control the movement of the expansion-valve, or simply to regulate the amount the throttle-valve is open, the first essential is that when the balls are out to their fullest extent, no steam shall be admitted to the cylinder, or at any rate none sufficient to move the engine round. That being made sure of, we next have to adjust the strength of the spring (usually in compression) by which the centrifugal force of the balls is more or less balanced. Now there is a particular degree of compression in a governor spring which may be termed the critical period of the governor under consideration; and it is in practice usually found by trial—by experimentally compressing the spring to the point at which its rate of increase will just keep pace with the increasing power of the balls to compress it; a suitable spring adapted to the circumstances, as determined by calculation and previous experience, being of course assumed.

At this critical point the governor will "hunt," as it is called—the centrifugal force being balanced at all points, a difference of one revolution, or less, in the engine, will cause the balls to fly in or out to the limits of their range; a most unhappy state of things for the engine, which embarks upon a series of short runs, as if possessed by a fiend.

By cautiously reducing the pressure upon the spring through the means provided for its adjustment, we gradually arrive at a point of extreme fineness of governing—unless this is prevented by friction or "sticking" of the governor or its gear. Unless every joint in the details which partake of the movement of the governor sleeve be perfectly free the governor will "hang" at some point in its movement, until the engine's speed is increased or reduced sufficiently to overcome the resistance. This is easily distinguishable from true "hunting," though at first sight the effect upon the engine is very much the same. Supposing all frictional resistance of this kind to be eliminated, it should be possible, upon throwing off the load, for the governor to settle down, after a few gentle oscillations, to a speed only one or two per cent. above the normal. This, however, is largely a matter of flywheel. If the energy in the flywheel is insufficient to absorb the fluctuation in the turning effort at the crank-pin, within, say, two per cent., it is manifestly waste of time to try and control the speed in revolutions per minute within this amount unless we desire to see every stroke of the engine represented by a movement of the governor sleeve. The contrivance known as a dashpot—consisting of a small cylinder filled with oil, and having a slightly leaky piston, past which the oil must squeeze its way—is sometimes used to correct a deficiency in flywheel power. This has a damping effect upon a too lively governor, but it is in no sense a substitute for a flywheel of proper weight.

It will be remembered that we began our adjustment by making the governor "hunt"; that we reduced the pressure upon the spring, giving (in the absence of detrimental friction) an almost exactly-poised but steady governor. If now we continue to reduce the spring-pressure we lose in sensitiveness, but gain stability. The governor will not be affected by small changes in the speed, but, on the other hand, when it responds to a change of speed sufficient to influence it at all, it will move to the required point without those preliminary oscillations which before characterised its movement. These relaxations of the spring-pressure, besides reducing the sensitiveness of the governor, have the effect also of reducing the rate of revolution of the engine; and should this have fallen below the required speed of rotation, either a new and slightly stronger spring must be put in, or the ratio of the belt-pulleys in the governor drive will have to be altered to suit.



MAP SHOWING ROUTES PROPOSED FOR THE SIMPLON TUNNEL FROM 1882 AND 1893.

THE PIERCING OF THE SIMPLON TUNNEL.

THE piercing of the Simplon Tunnel last week is the culmination of one of the most striking engineering feats of the present day; it is a remarkable instance of the triumph of mind over matter. As we go to press we hear with much regret of the death of one of the engineers—Signor Grassi—through an accident attributed to an escape of gas and the high temperature which prevailed during an inspection which followed the piercing of the tunnel. Several persons appear to have been overcome, and the condition of the engineer, Signor Bianco, was also reported to be very serious. Apart from this very regrettable incident, the long anticipated juncture of the north and south sections of tunnel appears to have admirably fulfilled the calculations of the engineers. Napoleon's road over the Simplon was commenced in 1800 and finished in 1806. It still offers the route for those who are in search of scenery, and whose time is unlimited. The new tunnel pierces the Alps at a lower elevation than any other route, viz., at 2,300 ft. above sea level.

Since the middle of the last century proposals have been made to tunnel the Simplon at various elevations, but it was not until 1893 that the Jura-Simplon Railway Company entered into a contract with Messrs. Brandt, Brandau and Co., of Winterthur, Switzerland, to construct a tunnel from Brieg, on the Swiss side, to Iselle, on the Italian side of the Pass on the final route shown in the above map. The amount of preliminary work was necessarily enormous as regards both engineering and international considerations, and by an arrangement with the Swiss and Italian Governments the plans were submitted to an international commission of tunnel experts, composed of Mr. Francis Fox, M.Inst.C.E. (of Westminster), Signor G. Colombo (of Milan), and Herr C. V. Wagner (of Vienna), who finally approved the present scheme. Among those prominently connected with the execution of the work have been Herr von Kager, Herr Edw. Sulzer (of Winterthur), Herr Brandau, Herr Nocher (of Zurich), Herr Pressel, etc. A treaty of authorisation for the construction was entered into between Switzerland and Italy in July, 1894.

With the exception of a short curve at each extremity the route follows a straight line. It is a double tunnel with two parallel sections, 55 ft. from centre to centre, each designed to carry a single line of rails. As yet only one of these has been constructed completely. The other consisting at present of a gallery some 6½ ft. high by 10 ft. wide is used for ventilation and purposes of construction. According to the international agreement between the two countries it need not be completed as a second tunnel until the gross receipts from traffic between the tunnel termini exceed £3,218 per mile per annum.

The exact length of the Simplon tunnel is 19,731 kilometres (12¼ miles); it is therefore by several miles the longest tunnel in the world. The mountain towers above it over 5,000 ft. on the average, and 7,000 ft. at the highest point. Cross-headings connect the two tunnels at intervals of 656 ft. The extreme height of the tunnel is 18 ft. above rail-level, its width varying from 14 ft. 9 in. at the latter point to 16 ft. 4 in. at a height of 6 ft. 6 in. above rails. The centre of the tunnel is for a distance of 1,310 ft. of wider section in order to admit of trains passing From this mid-distance there is a gradual slope to both termini, that on the north side having a ruling gradient of 2 per 1,000, while that on the south side has a ruling gradient of 7 per 1,000. The contract price for the tunnel is over £2,350,000, but, of course, the actual cost is as yet an unknown quantity.

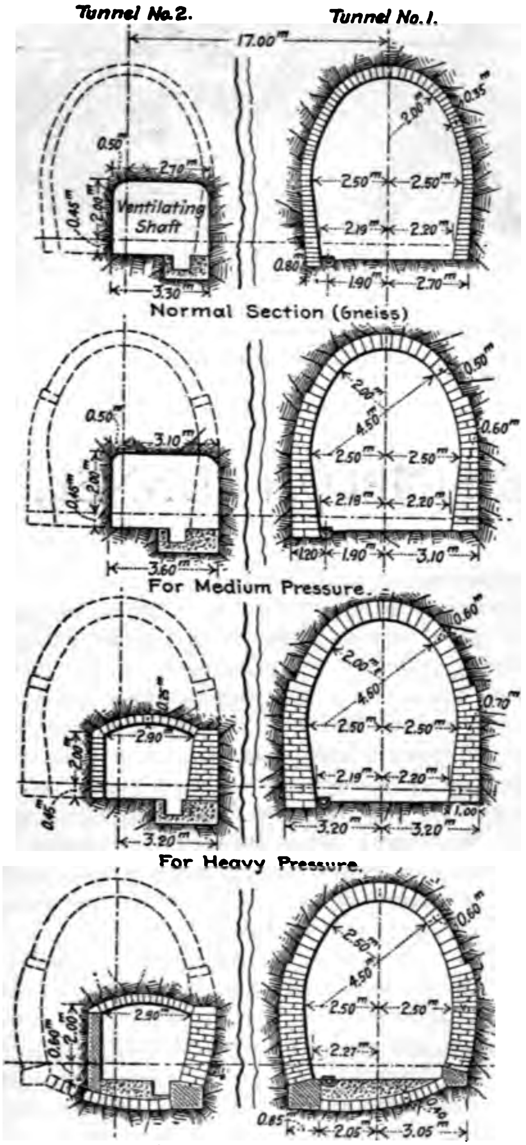


FIG. I. STANDARD SECTIONS OF SIMPLON TUNNEL IN DIFFERENT KINDS OF MATERIAL.

The execution of this remarkable work has called for admiration all along the line, whether one considers the mechanical perfection to which the contractors brought their machinery, or the organisation of the 3,000 men employed, who appear to have worked with an undivided enthusiasm, and an almost military precision. It says something for the brains employed upon the scheme that, in spite of the most trying conditions, an excellent standard of health has been maintained among the workers, the most careful arrangements having been made to protect them from the dangers attaching to sudden changes of temperature and wet clothes. Most careful attention has also been given to vital questions of ventilation and commissariat.

An important factor in the rapid execution of the work has been the Brandt rotary drill, shown in fig. 4. According to the Engineering News, to which we are indebted for the accompanying illustrations the feed of the rotary cutting tool is accomplished by the direct pressure of water in a large cylinder, the piston of which returns automatically when the water supply is cut off. The mandril carrying the boring bar and also the cutter are driven by means of two cylinders located above the feed-cylinder. These cylinders operate a shaft having a worm gear which meshes with a worm wheel centred on the mandril. The cylinders are 1¾ in. in diameter, and their pistons have a stroke of 2¾ in. They are operated by hydraulic pressure, and each uses normally one litre of water per second. The two cylinders are connected by cross waterways, and the piston of one acts as the valve of the other. The speed of the cutter necessarily varies for different densities of rock, but its highest speed is 10 revolutions per minute. The drill, as described, is mounted in groups of two or more on a heavy iron thrust bar, about 12 in. in diameter.

In the process of excavation followed, it has been usual to make an advance heading, 7 ft. 10 in. by 10 ft. 8 in., by means of the power drills. This has then been timbered and covered in for the passage of compressed air locos. and trucks. From this a shaft was driven to the roof line every 164 ft., and from these the tunnel has been opened out both ways to the complete section. Dynamite and blasting gelatine have been the explosives used at the Italian and Swiss ends respectively, and, as a rule, eight blast holes were drilled at the face, the machinery and men being withdrawn for refuge to the cross galleries or service tunnel. In 1898 1,342 ft. were bored, each of the successive years up to and including 1903, being responsible for over 11,000 ft.; while in 1904, 5,457 ft. were excavated, and during the present year 557 ft. have been taken out. The work, of course, proceeded simultaneously from both ends, but in May last driving at the Brigue end was stopped by hot springs.

An engineer connected with the work deals in the Times with some of the difficulties encountered: The gradient ascends from each entrance towards the middle of the Alps for drainage purposes, and it is due to this that it has been possible to carry on the work, as the yield of the great springs flows away by gravitation. At 4,400 metres from the Italian entrance a very large spring of cold water of 12,500 gallons per minute—in fact, a river—was struck, and this caused several months of delay at this end of the tunnel. The ground was very treacherous, so that it had to be heavily timbered; the stoutest and largest timbers were crushed, and steel girders had to take their place; but so great was the weight that these were twisted and distorted, and finally were only held in their place by being strengthened with concrete in cement. This enabled the driving of the gallery to proceed, but meanwhile the Brigue end had reached the top of the gradient in the middle of the tunnel, although the rock temperature had risen to 132 deg. F., fully 25 deg. more than had been expected. With a view to saving time, it was then decided to continue this and drive down the Italian gradient to meet the corresponding tunnel coming up from Iselle, although it was quite anticipated that difficulties would be met with in driving downhill. In this the contractors were not deceived, for very soon hot springs of 111 deg. F., and of considerable volume, were met with. These springs are far hotter than is bearable, but the engineers adopted the comparatively simple expedient of throwing jets of cold water into the fissures and thus reducing the temperature as far as was necessary. The cold water is driven into the tunnel by centrifugal pumps, through pipes surrounded by non-conducting material, so that the water is delivered as cool as possible.

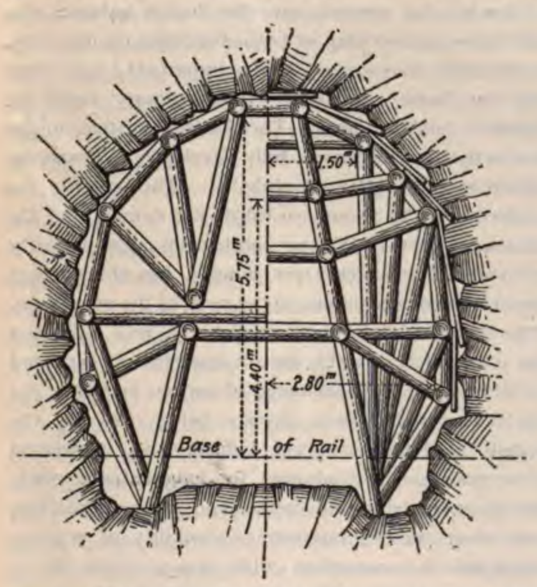


FIG. 2. STANDARD FORM OF TIMBERING FOR SIMPLON TUNNEL.

FIG. 3. EXTRA HEAVY FORM OF TIMBERING FOR THE TUNNEL.

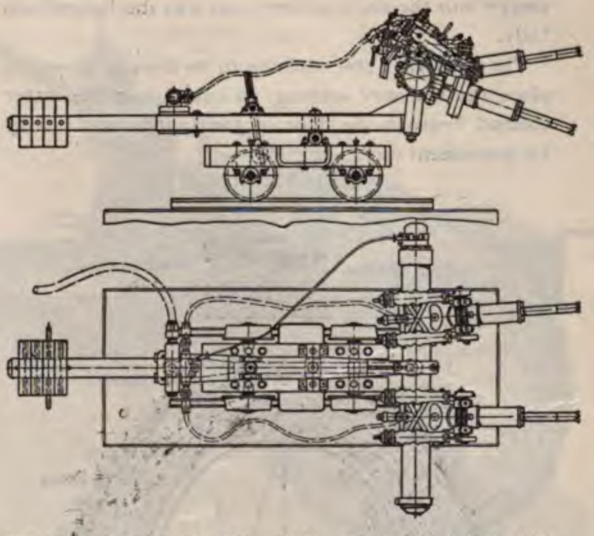


FIG. 4. ELEVATION AND PLAN OF BRANDT ROTARY DRILL MOUNTED FOR OPERATION.

At a point 10,376 metres from the northern entrance, or 809 metres from the top of the gradient, further hot springs were encountered of such a volume that they filled the descending portion of the work with hot water, and stopped driving at the Brigue end.

Meanwhile the work at the Italian face was pushed on, until in September last another hot spring of 114 deg. F. was encountered in each of the parallel galleries, amounting to about 1,800 gallons per minute, and considerable difficulty and great delay were caused. By dint of extraordinary perseverance and courage, these springs were passed and soon left behind by the Brandt drill. The volume of water then emitted from the tunnel was still about 12,000 gallons per minute. When the actual junction of the galleries was effected the accumulated hot water on the Swiss side found its escape into the south gallery, and was discharged into Italy.

The work that now remains to be done is to put in place the masonry arching, to cover over the water channel beneath the floor of the tunnel, and to lay the permanent way.

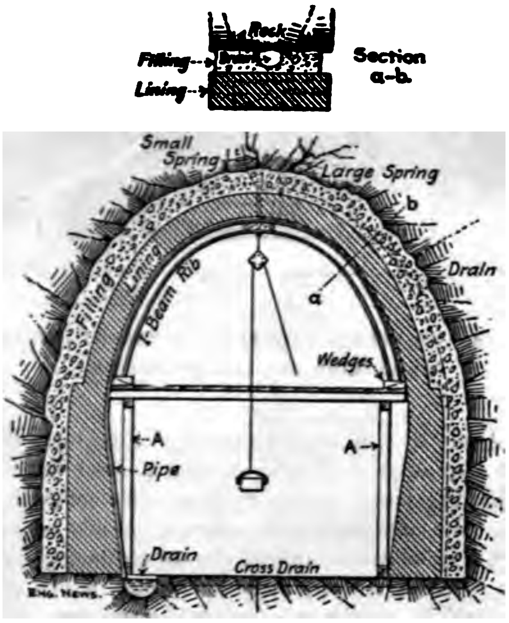


FIG. 5. DIAGRAM SHOWING METHOD OF CONSTRUCTING LINING.

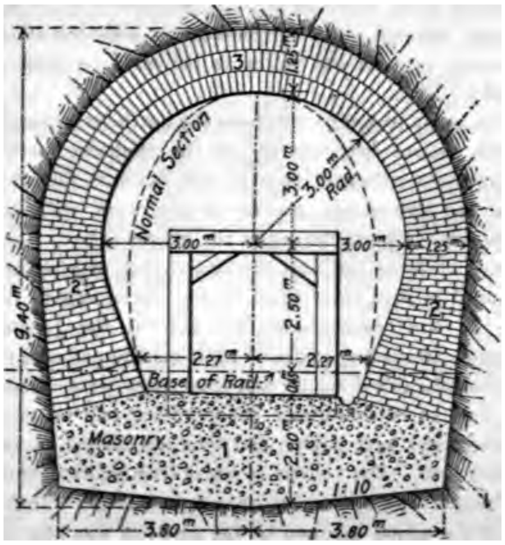


FIG 6. LINING USED FOR VERY HEAVY PRESSURES.

TYPE-SETTING BY TELEGRAPH.

At the meeting of the Institution of Electrical Engineers on Thursday last Mr. Donald Murray read a paper on "Setting Type by Telegraph." The author said that the whole of the problems connected with the handling of types had proved very refractory, and that the complexities culminated in the printing telegraph, where the problem was to set type at a distance. The result had been that it was only within recent years that any really successful machines had emerged from the domain of experiment with [illegible] exception of the stock tickers and Hughes Printing Telegraph. Undoubtedly the best alphabet for machine telegraphy was that used in the Baudot and Murray systems. The Baudot was the one alphabet which had any prospect of coming into general use for machine telegraphy, and that being so it only remained to utilise it as the basis of a printing telegraph system. In the Murray system, selected as an example for practical illustration, the distributor was a punch-arm and a moving-paper tape, and in that form closely resembled the Wheatstone recorder, save that instead of inking the tape it punched holes in it. In the method of translating and printing after distribution of the signals the Murray system differs from all previous printing telegraphs, and belonged rather to the class of automatic type-setting machines. In this system no attempt was made to secure synchronism; it was an isochronous system, and the duplex balance was used to secure working in both directions on one wire. Retardation thus ceased to be important, and there was the further advantage that ordinary repeating stations could be used. The Murray system might be shortly described as a fully-developed Wheatstone system using the Baudot alphabet. The speed of the printer ran up to about 150 words per minute, and the automatic portion of the mechanism ran perfectly up to about 200 words per minute, but the average output was not more than 50 per cent. of the maximum. With the new motor-driven printer it was estimated that it would be possible for six operators at each end of a Murray circuit to exchange about 400 messages per hour. The system was already being used by the English and German Post Offices, and it seemed to be pre-eminently adapted for long-distance work, iron wires, underground cables, and press dispatches, while there was an interesting possibility of printing telegraphy in connection with ocean cables by a combination of the Murray system with Mr. S. G. Brown's cable relayer and perforator and the Cooke alphabet. The Murray printer was originally designed for automatic type-setting by telegraph.

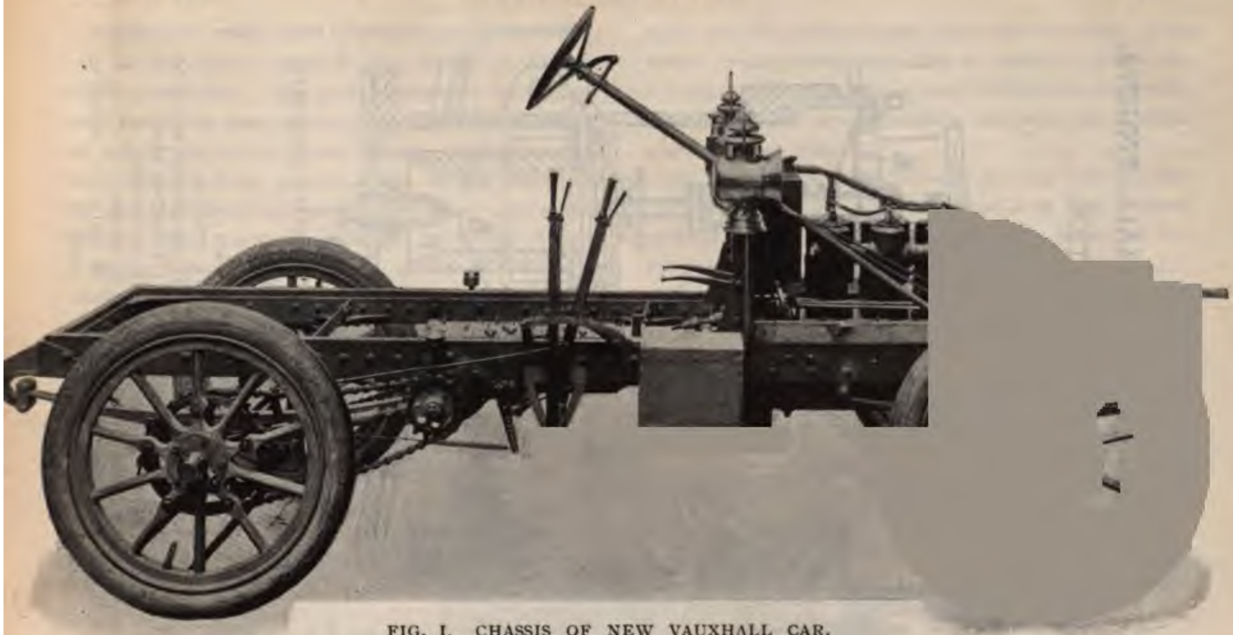


FIG. I. CHASSIS OF NEW VAUXHALL CAR.

OLYMPIA MOTOR SHOW.

(*Continued from page* 404.)

VAUXHALL IRONWORKS COMPANY, LTD.

In the three-cylinder standard car recently introduced by this Company several new features have been embodied which call for some detailed notice. The chassis of the new car is shown in fig. 1. It is constructed of stamped steel, the longitudinal members being parallel throughout, and therefore affording direct support to the engine-crank chamber and gear box. The three cylinders are separately cast and mounted on the crank chamber. The gear gives three speeds forward and reverse at the normal engine speed of 950 revolutions. A high-tension ignition is employed.

A longitudinal section of the 12-h.p. Vauxhall engine is shown in fig. 2. It will be noted that the crankshaft, made in three throws, runs in four bearings, that nearest the flywheel being of considerable length. Accessibility has been brought to a high pitch, and any necessary work can be done to the crankshaft or big and little ends of connecting rods without the necessity for dismounting any cylinder. This is accomplished by the detachment of the inspection plates B1 B1 and the removal of the lower portion of the crank chamber B. The piston body is made long, and the rings set quite close to the crown, giving protection from dust and oil to the combustion chamber. Another good point is the arrangement of the variable nduction valve lift.

The carburetter is illustrated in fig. 4. The orifices of the tube and cap M coincide, and by the rotation of the tube the air supply can be controlled up to a certain speed, and at greater speed the automatic air valve E is brought into action, and admits more air. The radiator consisting of four tiers of seven flanged tubes is of somewhat novel design, and the type constitutes a distinct advance upon older forms.

An end view and section of the Vauxhall clutch are shown in fig. 3, which presents one or two points of interest. One is the addition, as compared with former types of three leather-covered spring pads, one of which is shown at F. Those pads are carried on studs H, and plunge against the small coil springs set in the bosses G, and are so placed as to make for smoothness and absence of jolting when suddenly letting on the clutch. Another good feature is the abolition of the usual spiral clutch spring and its replacement by easily-adjusted clutch spring-bars.

A countershaft drive is employed actuating the rear road wheels through the agency of side chains. On the right-hand side half of the countershaft, and placed outside the gear box, is the balance gear, the case of which forms the drum for a very wide pedal-applied band brake. Brake drums are also fitted to the road wheels, the bands being applied to these by means of the side lever.

SECTIONAL DRAWINGS OF VAUXHALL ENGINE, CLUTCH, AND CARBURETTER.

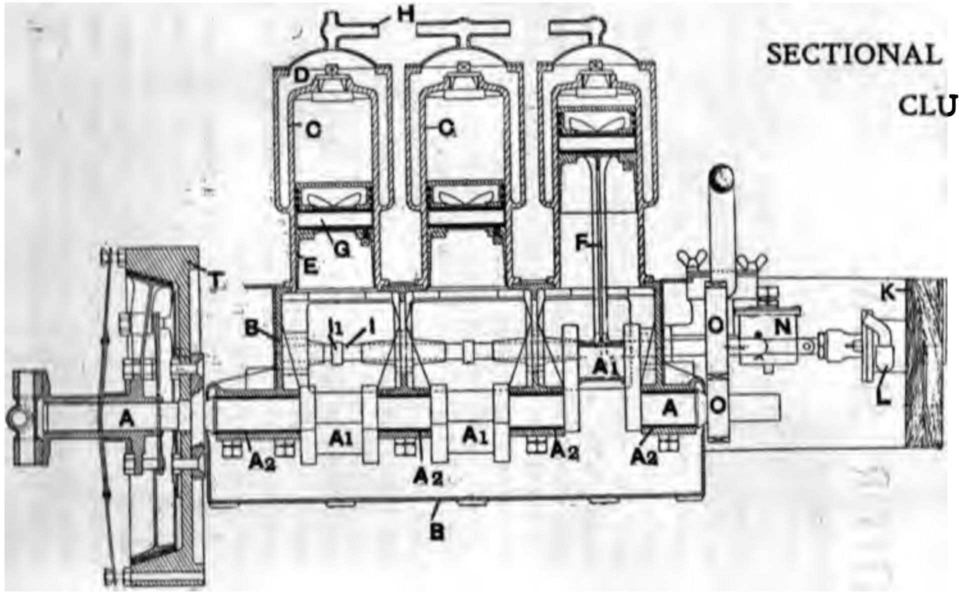


FIG 2. LONGITUDINAL SECTION OF 12-H.P. VAUXHALL ENGINE.

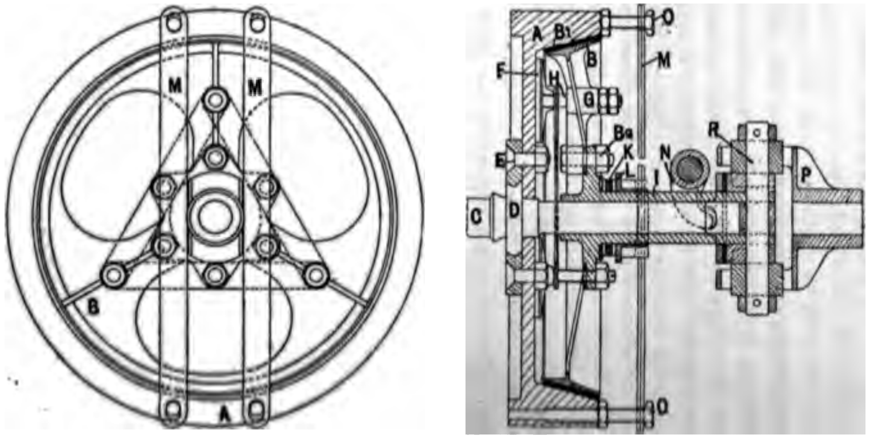


FIG. 3. END VIEW AND SECTION OF THE VAUXHALL CLUTCH.

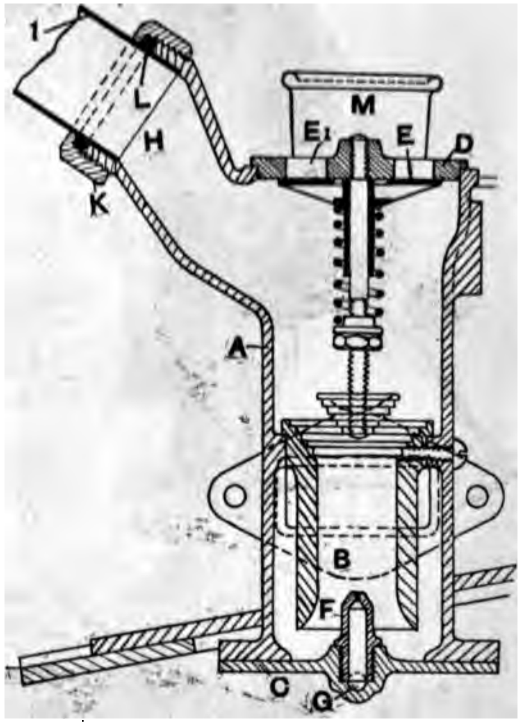


FIG. 4. SECTION OF THE VAUXHALL AUTOMATIC CARBURETTER.

A, body of carburetter
B, jet chamber
C, lower cover plate carrying petrol jet
D, upper flange forming automatic air valve seating
E, automatic air valve
E1, air ports

F, jet
G, petrol feed
H, gas passage to engine
I, induction pipe
K, union nut
L, washer
M, main air adjusting cap

WOLSELEY TOOL AND MOTOR-CAR COMPANY.

This Company was well represented at Olympia with three stands. The main features of the Wolseley cars have not been altered, but some improvements in details are to be noted tending towards simplification and easier control. The section models on the car stand showing, among other things, the working of an internal combustion engine, naturally attracted a good deal of attention, and it was a well-devised scheme for the enlightenment of the technically uninstructed.

In the Marine section the company showed a crankshaft for a 220-h.p. six-cylinder engine, a 24-h.p. four-cylinder marine engine, and one of 50-h.p. This latter created something like a sensation when exhibited in the Grand Palais, and it affords an admirable example of the strides recently made by the British marine motor industry.

Fig. 5 shows the Wolseley 60-h.p. four-cylinder vertical petrol engine. The motor is of the enclosed vertical type developing 60 h.p. at a speed of 600 revolutions.

The four induction valve boxes are held in place by two bridges, and by the removal of two nuts a bridge can be removed with its levers intact, and the induction valve boxes lifted out, leaving all the valves of two

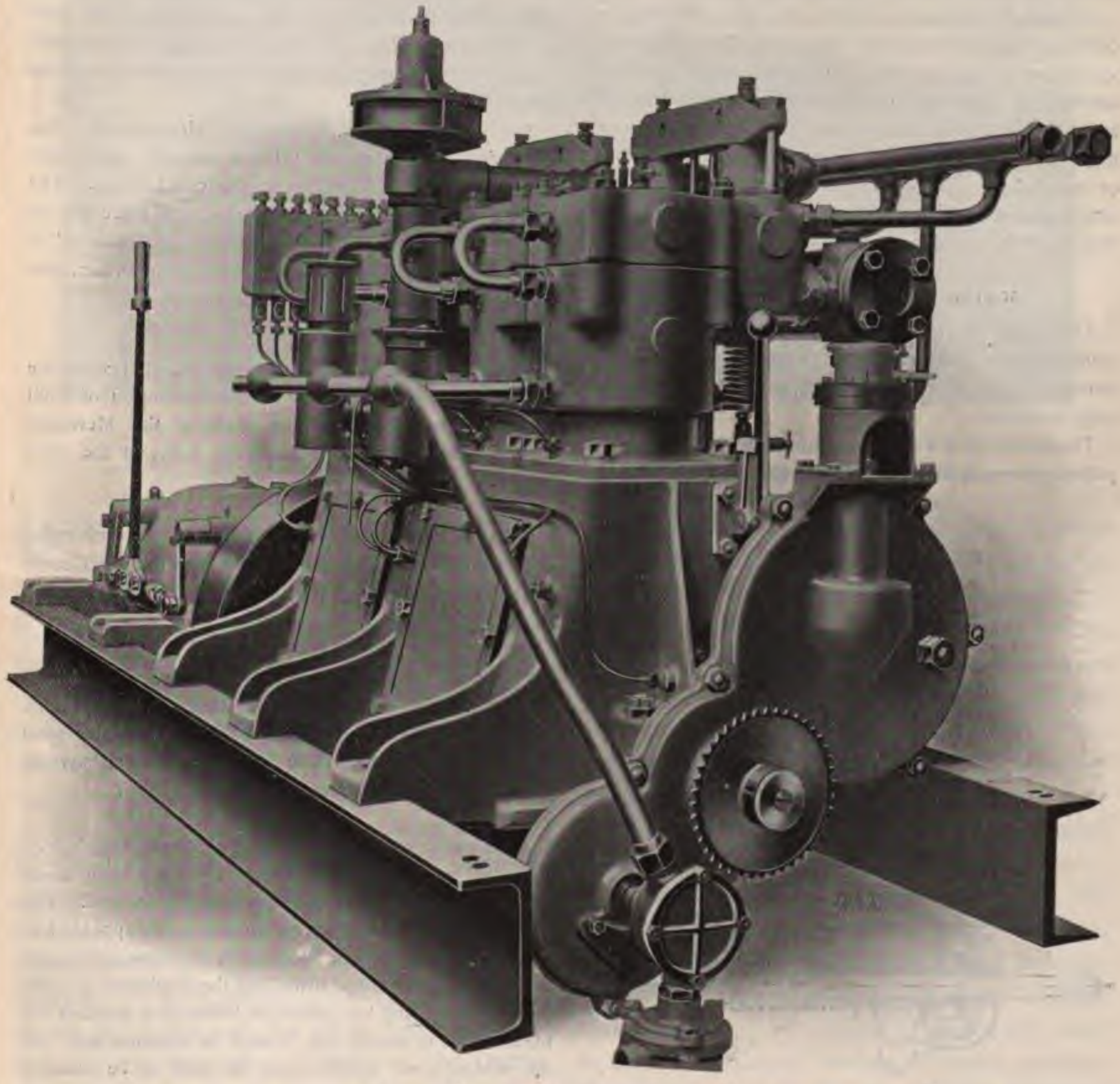


FIG. 5. 60-H.P. WOLSELEY LAUNCH MOTOR.

cylinders free. It will be seen by this means the valves are rendered very accessible. The camshaft is made in one piece, with all its cams solid with it, and is enclosed in an extension of the crank chamber. Half compression cams are fitted, which can be brought into action by a lever, to ease the starting of the motor. The ignition is electric high-tension by means of accumulators and induction coil with tremblers, but, if desired, high-tension magneto ignition is also fitted. The carburetter, which is mounted on the engine case, is of the float feed spray type, having one jet and float feed for the four cylinders.

The carburreter is water-jacketed, part of the warm circulating water passing through the jacket.

If desired the engine can be run on petroleum, a different carburetter being required. The petroleum vapouriser is of the Wolseley patent type, exhaust heated. In addition to the governor a hand throttle is fitted, and also an accelerator by which the governor may be entirely cut out of action when it is desired to race the engine above its governing speed. The entire motor with flywheel weighs just under 15 cwt., that is 28 lb. per developed horse-power.

ALBION MOTOR-CAR COMPANY.

The motor is of the two-cylinder vertical balanced type, having cylinders 4⅞ in. bore by 5 in. stroke, developing 16 b.h.p. The inlet valves are mechanically operated.

The motor is governed on the inlet by the Murray patent governor (fig. 6), which automatically regulates the speed, mixture, and ignition advance, and is controlled by a single lever. The centrifugal part of the governor is so designed that the sliding sleeve (a) begins to move along the governor shaft when the engine is running at 180 revolutions per minute, and only reaches the limits of its travel when the engine is running at 1,000 revolutions per minute; there is therefore a definite position of this sleeve for every speed of the engine within these limits, and by means of a hand lever (*b*) which is fitted below the steering wheel the driver can determine at will the speed at which the governor will close the throttle. At whatever speed the governor lever is set, it is claimed the car will maintain this steady speed up and down hill and on the level without any attention on the part of the driver. This, it is held, overcomes the objection to the ordinary methods used on cars for varying the speed of the governor.

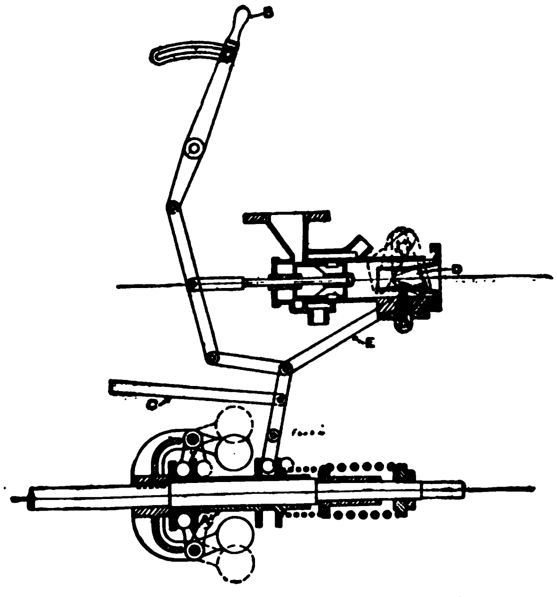


FIG. 6. MURRAY PATENT GOVERNOR.

The ignition is magneto-electric, the current being generated by the patent Albion magneto generator, which is mounted directly on the crank shaft. The armature and coils are stationary, and there are no sliding contacts, no commutators, or brushes. It is claimed to be absolutely positive in its action, and no batteries or accumulators are required.

Sir Guilford Molesworth, the president, will occupy the chair at the annual dinner of the Institution of Civil Engineers, which is to take place at the Merchant Taylors' Hall, Threadneedle Street, E.C., on the 22nd instant.

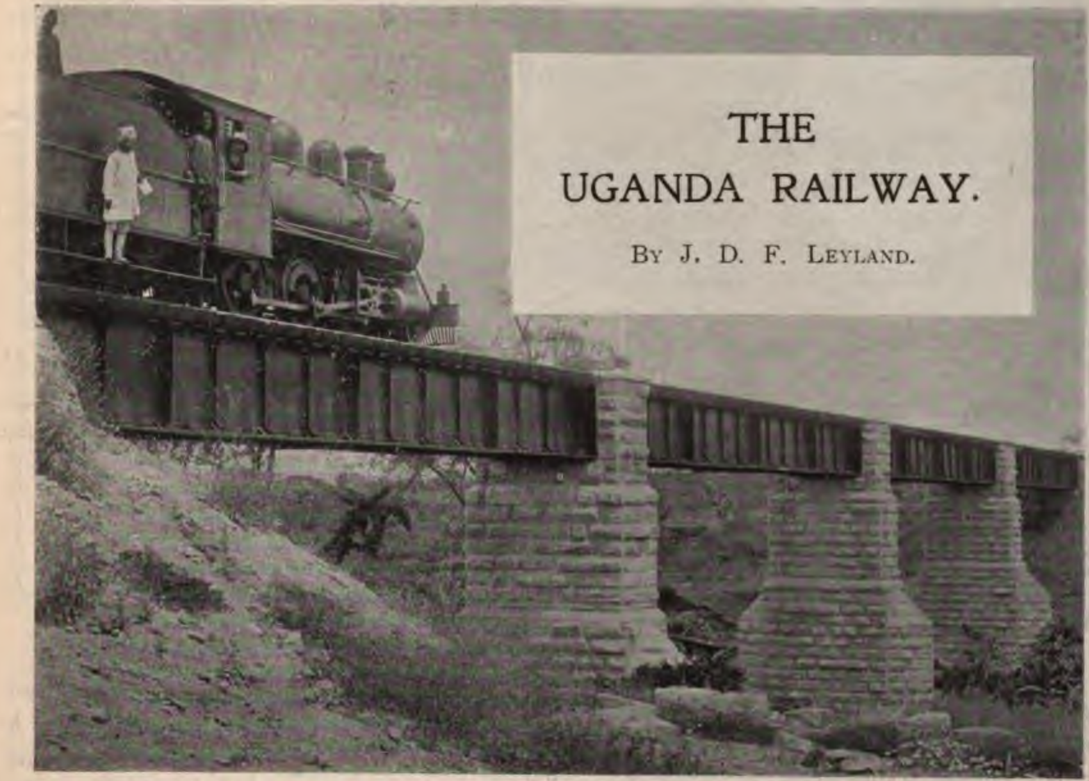
The Civil Engineering Department of the University of Leeds has sustained a loss in the death of Mr. George Wilson, D.Sc., A.M.I.C.E., Lecturer in Civil Engineering at the University.

The coal market is quiet, Cardiff correspondents reporting a quiet market for large steams, spot shipments being lower all round, although there is a better tone for forward delivery. The Newcastle market is weak, prices for current shipment showing a decline.

American correspondents report active dealings in iron and steel products. Orders for rails have been freely placed. and structural steel has been in demand. The United States Steel Corporation has again appeared in the market as a buyer. Reports from home centres are not cast in so hopeful a strain, but the shipbuilding trade remains good, and the orders for locomotive engines for Japan ought to benefit that branch of engineering. On the whole, steel makers may be said to be steadily employed.

THE UGANDA RAILWAY.

BY J. D. F. LEYLAND.



TSAVO BRIDGE AT MILE 132.
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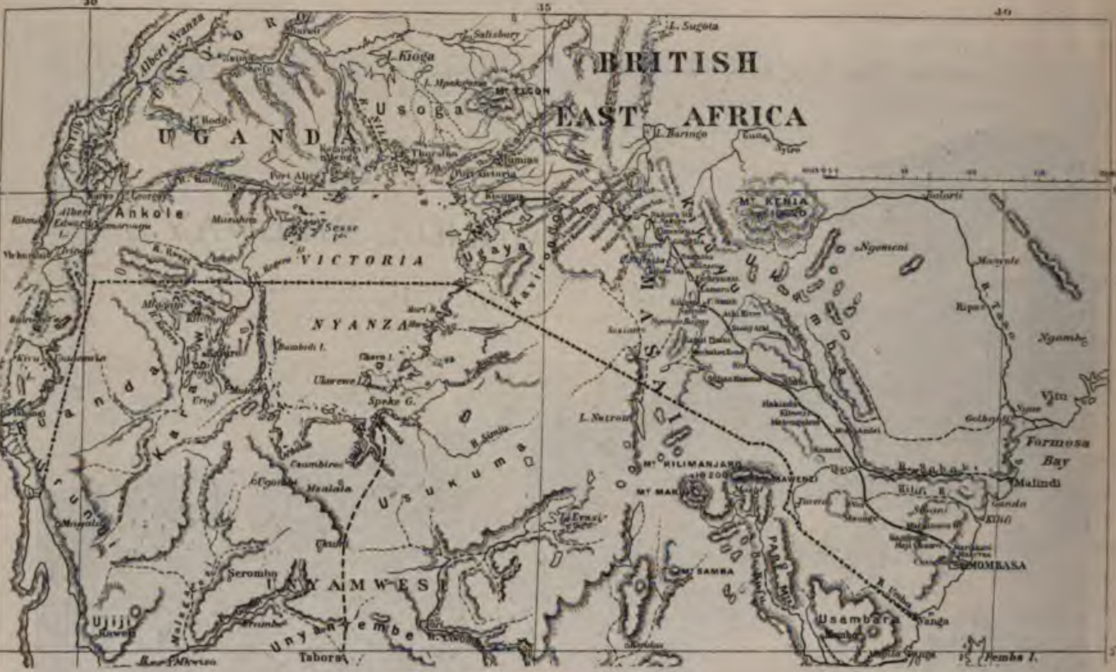
OUR presence in East Africa was necessary to uphold our position there and to put a stop to the sea-borne slave-trade carried on by the Arabs, which had its source in the interior of the country. Experience had shown that coast police and a cruising squadron could not do this successfully. The conclusion, then, seemed inevitable that the only real remedy was to build a railway carrying into the country civilising influence and the means of control. It was required to open up by railway and water communication the whole coast-line of about 1,000 miles of Lake Victoria together with the adjoining fertile and populous districts. The Uganda Railway is the first to tap the Lake, and the whole trade of those districts will naturally gravitate in the course of time into this channel.

On December 17th, 1890, Sir William Mackinnon, chairman of the British East Africa Company, wrote a letter to Lord Salisbury proposing the building of a railway through British East Africa as the most effectual means of fulfilling our obligations under the Brussels Act of 1890 for the suppression of slavery. Accordingly, towards the end of 1891, a survey party, under the command of Captain (now Brigadier-General) Macdonald, was organised by the Government to examine and report upon a route for a railway to connect the seaport of Mombasa with Lake Victoria. From this preliminary reconnaisance an estimate was prepared which gave £3,409 as the average cost per mile. Sir Guilford Molesworth said he considered this far too low for such a country. From his own experience of Indian railways,



MAP OF UGANDA RAILWAY.

some of which resembled the proposed Uganda Line, the average cost of these was about £7,000 per mile. He stated that these were not subject to many of the drawbacks which affected the Uganda Route.

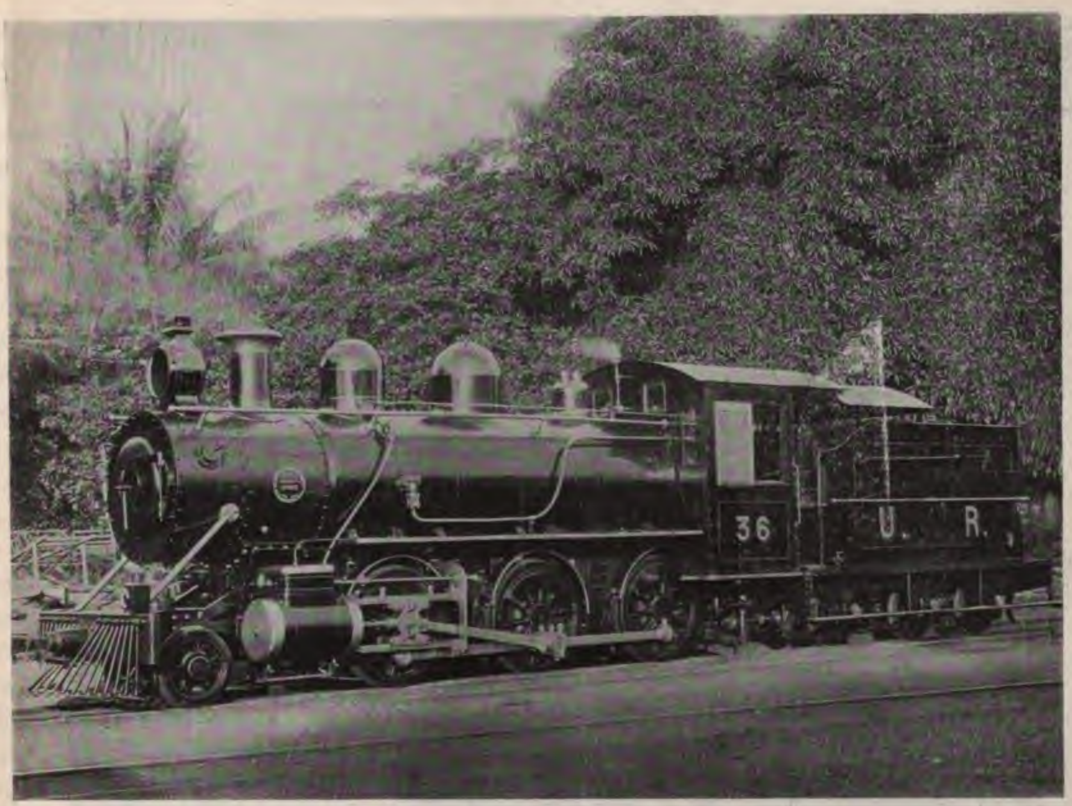
In 1895 it was determined that the railway should be constructed by Government, and, on December 11th in the same year, Mr. (now Sir George) Whitehouse, the chief engineer, and his staff arrived at the Island of Mombasa.

THE FIXTURE AND CHARACTER OF THE ROUTE.

It was originally intended that the railway should connect Mombasa with Port Victoria, on Lake Victoria, but, as the result of further surveys, it was found that the length of the railway would be reduced by 93 miles by running it to the head of Kavirondo Gulf. The station at that point has been named Port Florence.

The country traversed by the railway is, to a great extent, desert, and, as a rule, waterless, sparsely populated, and without resources. Most of the Island of Mombasa was thick jungle. From the coast to the summit of the Kikuyu escarpment, about 300 miles inland, there is a general rise to the height of 7,000 ft. At this point comes a sudden descent of about 1,500 ft. into the Great Rift valley, which has an average width of about twenty-eight miles, and extends north and south considerably beyond the limits of British territory on either side. On the opposite side of the rift is the Mau escarpment, similar and parallel to the Kikuyu escarpment, but even more formidable, rising to the height of about 8,500 ft., and about 2,500 ft. above the floor of the rift. The country then falls sharply towards the level of Lake Victoria.

From the coast towards the lake the first fifteen miles is cultivated; then there is a sparsely wooded tract, about thirty miles wide, and the Taru desert, fifty miles in width, which is absolutely waterless, and covered with almost impenetrable jungle; next is another hundred and fifty miles of jungle, not quite so dense, with very little water, except the Tsavo river, about hundred and thirty miles from the coast; and then the Athi plains stretch for about fifty



ONE OF THE AMERICAN LOCOMOTIVES IN USE ON THE UGANDA RAILWAY.

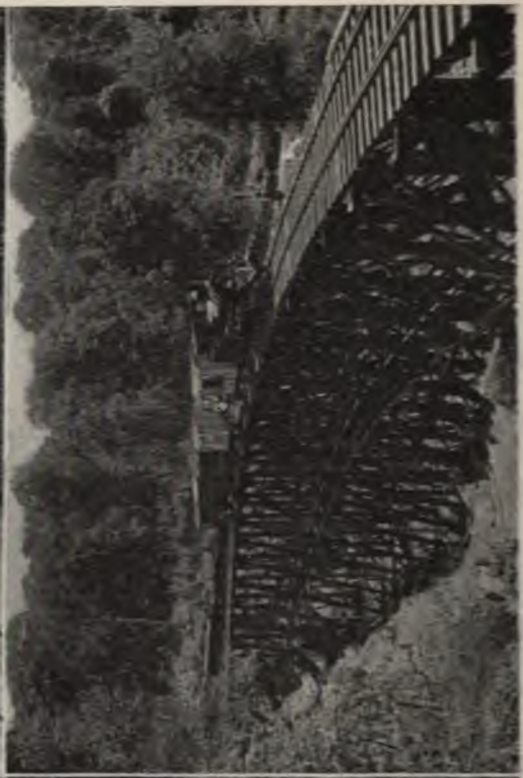
miles, which are treeless and almost waterless. Up to this point there is no shade from the sun ; the jungle only serves to shut out all wind. and the water is hard and brackish. Beyond, the character of the country changes abruptly ; it becomes well wooded, cultivated, and intersected by numerous streams. The slopes of the escarpments are covered with dense forest. All the Rift lakes except Lake Naivasha, are salt.

Shortly after leaving the coast the line surmounts the Rabai hills, crosses the Taru desert to Voi, then follows the course of the Mto-wa-mawe valley, and across the Athi plains to Nairobi ; next it crosses the Kikuyu escarpment down into the Great Rift valley and over the Mau escarpment, and descends to the shores of the Victoria Nyanza. At the Kikuyu escarpment, mile 355 from the coast, the line had to climb to a height of 7,900 ft., then descend to 6,000 ft. At mile 430, and again at the Mau escarpment, mile 490, it had to climb to 8,320 ft., descending to the lake at a level of 3,726 ft. above the sea, at mile 584. Over the greater part of the last hundred miles of this route, previous to September, 1898, no European had ever trodden. Commander Whitehouse in a paper read before the Society of Arts, said : "Never before has a railway been built under such extraordinary conditions, or caused such radical changes in the country through which it has passed."

The railway has comparatively long stretches of easy work, but the great altitude which has to be reached, the sudden ascents and descents, the severity of the gradients, and the sharpness of the curves, necessary to avoid expensive construction, involve difficulties equal to those of a mountain railway. Permanent telegraph wires on suitable iron posts follow the railway.

NJORO STATION YARD, MILE 462.

REVERSE (TEMPORARY LINE) AT MILE 485.



VIEW AT MILE 507.

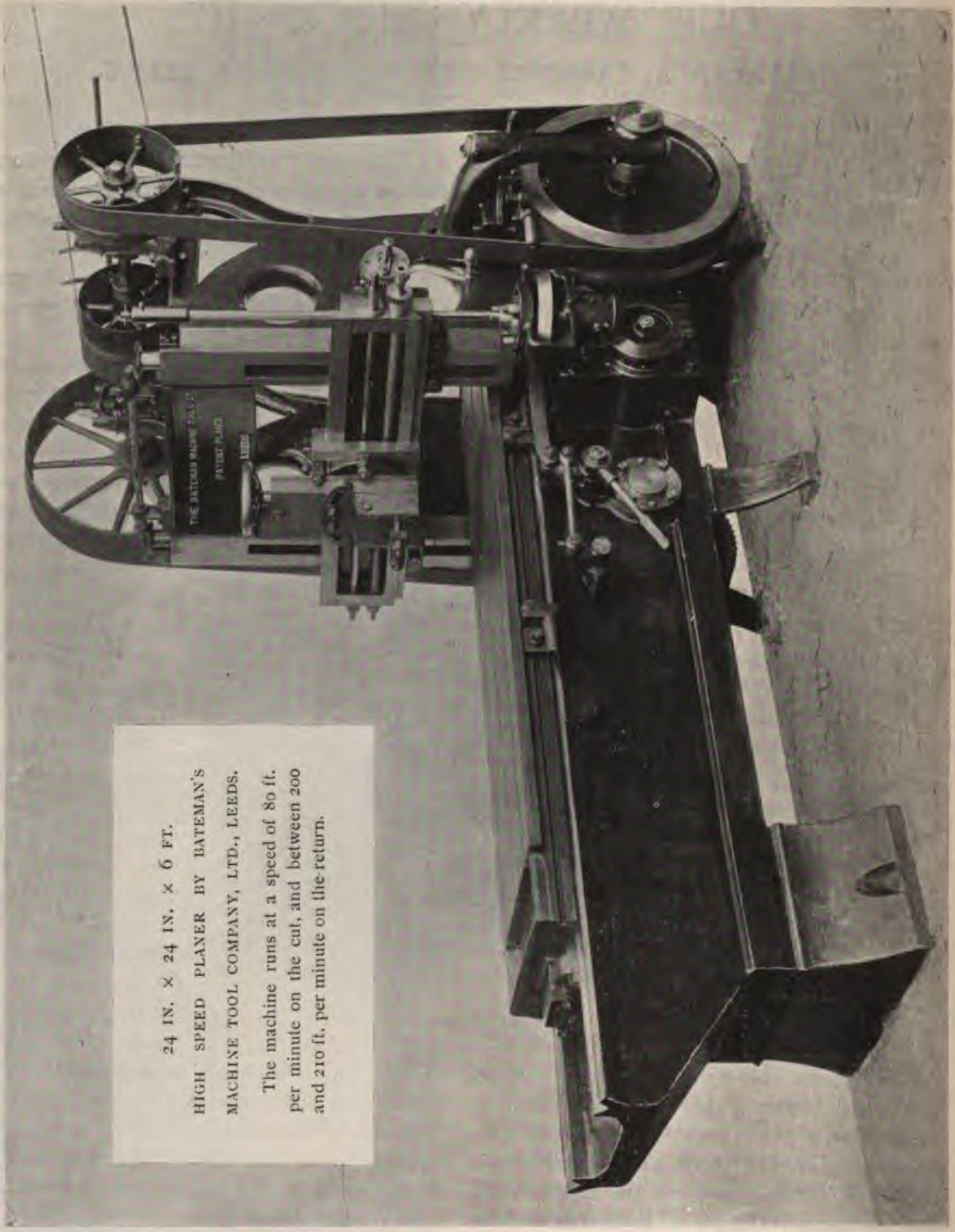
TEMPORARY TRESTLE BRIDGE AT MILE 476.

There are thirty-two permanent stations on the line, and its total length from Mombasa to Port Florence is 586 miles. The ruling gradient is 1 in 50. The sharpest curve on the main line is of 537 ft. radius. All along the line the Chief Engineer took up an ample amount of land on either side, partly for the purposes of extensions, etc., and partly to prevent speculators buying it up at a very low price, and then putting a high price upon it. The surveys and sections for the whole line were not completed until April, 1900.

THE DIFFICULTIES AND COUNTERACTING ADVANTAGEOUS CONDITIONS.

This railway is unique in the fact that nowhere before had a railway been constructed amid such great difficulties, and in so short a space of time. Sir Guilford Molesworth, in his report of 1899, said : " Great credit is due to the Chief Engineer for the manner in which he has initiated and developed this organisation under circumstances of unparalleled difficulty." He also said, concerning the descent into the Great Rift Valley : " I consider the whole line, as staked out from Nairobi to the lowest point of the descent, a distance of forty-nine miles, both in conception and execution, a masterpiece of engineering skill, which reflects the greatest credit upon all concerned." When Mr. (now Sir George) Whitehouse first went out to Mombasa he had to construct extensive jetties, and erect cranes for the landing of railway material and stores, to lay down moorings and buoys, and to sink wells, at the port of Kilindini, which is on the opposite side of the Island of Mombasa, and had been selected by Captain Macdonald in preference to Mombasa itself. Then a line had to be constructed with a gradient of 1 in 50 from the jetties to the railway station, which is some 70 ft. or 80 ft. above the sea level. No steam launches were available, and all labour had to be imported from a distant country, namely, India, and housed on arrival. The members of the staff were new to one another, to the country, and to the conditions of working. No supplies whatever were available, and everything had to be imported. The country was in a disturbed state, and survey parties could not be sent out at first without a military escort.

The first engineering difficulty that was met with was that of crossing the arm of the sea between the island and the mainland. Captain Macdonald suggested in his scheme the building of an embankment, but this was found to be impossible, as the strait is 14 ft. deep, and has a tide running at four knots an hour. The construction of a temporary wooden bridge was immediately commenced, pending the building of the permanent one of steel, as no work could be carried out on the mainland until this was achieved. This temporary structure made a diversion of two miles necessary. Following this the Rabai hills had to be surmounted, involving some of the heaviest work on the line. To push on the rails rapidly it was necessary to put in a considerable length of temporary line. Similar temporary diversions, beginning at the Macupa bridge, mile 2, were adopted at intervals along the line. The locomotive power was insufficient at first, and it was difficult to keep railhead supplied with materials. At about mile 50 the line enters the Taru desert, which has been referred to, and the earthwork here was a mere nothing when compared with the difficulty of clearing away the jungle, which will not burn readily, and grubbing up the stumps. From mile 162, to Kibwezi, mile 193, the work was very heavy, and necessitated numerous diversions, several considerable bridges, embankments, and rock cuttings. In consequence of the general character of the line and of the numerous diversions, an abnormally large number of locomotives was required in order to insure satisfactory progress. At mile 362 four temporary rope inclines had to be constructed with great labour. The reason for the construction of these inclines is dealt with hereafter.



24 IN. × 24 IN. × 6 FT.

HIGH SPEED PLANER BY BATEMAN'S MACHINE TOOL COMPANY, LTD., LEEDS.

The machine runs at a speed of 80 ft. per minute on the cut, and between 200 and 210 ft. per minute on the return.

HIGH-SPEED PLANERS,

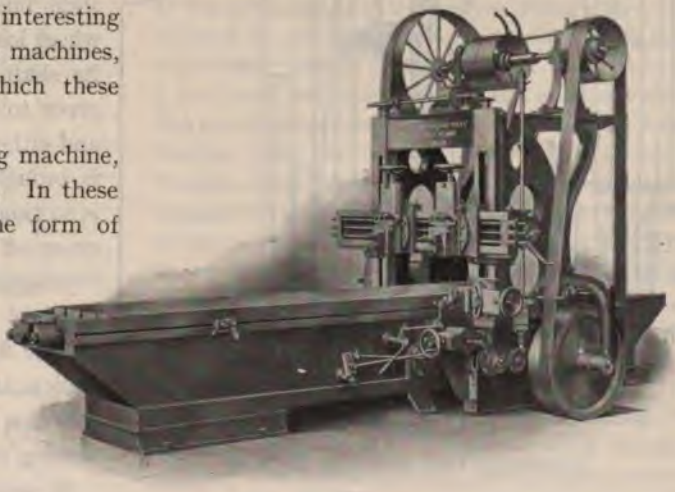
By Bateman's Machine Tool Company, Ltd., Leeds.

THE illustration below shows the latest type of high-speed planer designed by Bateman's Machine Tool Company, Ltd., of Leeds. Considerable attention has been bestowed by this firm upon the details of these machines, with the result that very exceptional qualities have been secured, more particularly in the direction of smooth running and rapid speed. This will be understood when it is stated that the 36 in. by 36 in. by 10 ft. machine, with side stool, shown herewith works at a speed of 55 to 60 ft. per minute on the cut and 160 to 170 ft. per minute on the return, while the machine illustrated on the opposite page is claimed to be the fastest planing machine in the world. This is a 24 in. by 24 in. by 6 ft. machine, which is at present running in the shops of the firm at a speed of 80 ft. per minute on the cut and between 200 and 210 ft. per minute on the return. It will be interesting to examine the construction of these machines, and to glance at the means by which these results are obtained.

In the ordinary rack-driven planing machine, the rack is bolted direct to the table. In these planers a patent is introduced in the form of a sliding bar, to which the rack is fixed, and which has a short longitudinal motion in a groove on the underside of the table. To a cross head at one end of the sliding bar, spindles are secured carrying adjustable springs. These springs absorb all the shock of reversal, and their compression helps the table to start in the new direction at reversal, so that the belts are consequently relieved of much of the extra strain to which they are subjected in the ordinary type of planer.

The beds of these machines are heavily designed, being extra deep, and strongly barred, and in all but the small machines are of double box form without feet. They are unusually long, the run-over of table consequently being very short. The strongly webbed tables are provided with longitudinal T slots, varying in number according to the size of table, together with a series of stop holes for the convenience of setting the work quickly.

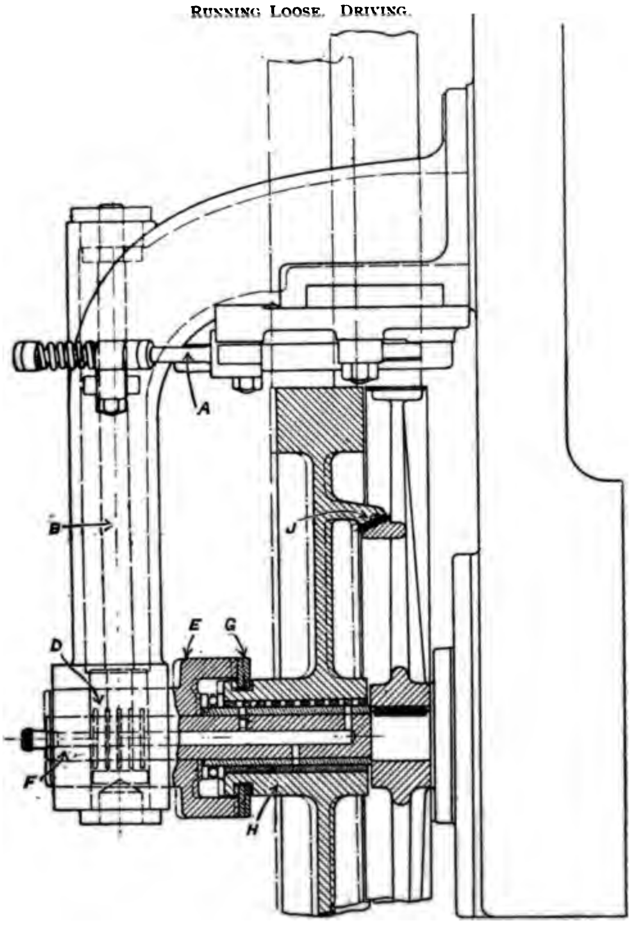
The deep cross-rail has large bearing surfaces, and, except on the small machines, can be raised and lowered by power as well as by hand. Its length provides, that, where two tool heads are used, the near head can be traversed across the



36 IN. × 36 IN. × 10 FT. PLANER

whole width between the housings quite independently of the off head. The planers, if of medium or large size, are built to carry two tool-heads on the cross-rail, and one side tool-head on the near housing, and can also be fitted with a side tool-head on the off side. The feeds for the cross-rail tool-heads are entirely automatic. They are started, changed, or stopped instantly while the machine is at work, and are actuated by a new friction arrangement through a vertical shaft carried on ball bearings. The vertical feeds on the side tool-heads are actuated by the knocking-off arrangement.

The high-speed gearing is chiefly of cast steel and is lubricated in an oil bath. The other gearing is of cast iron, the high-speed shafts being of carbon steel, and running suitably bushed in bearings.



FLYWHEEL AND FRICTION CLUTCH.

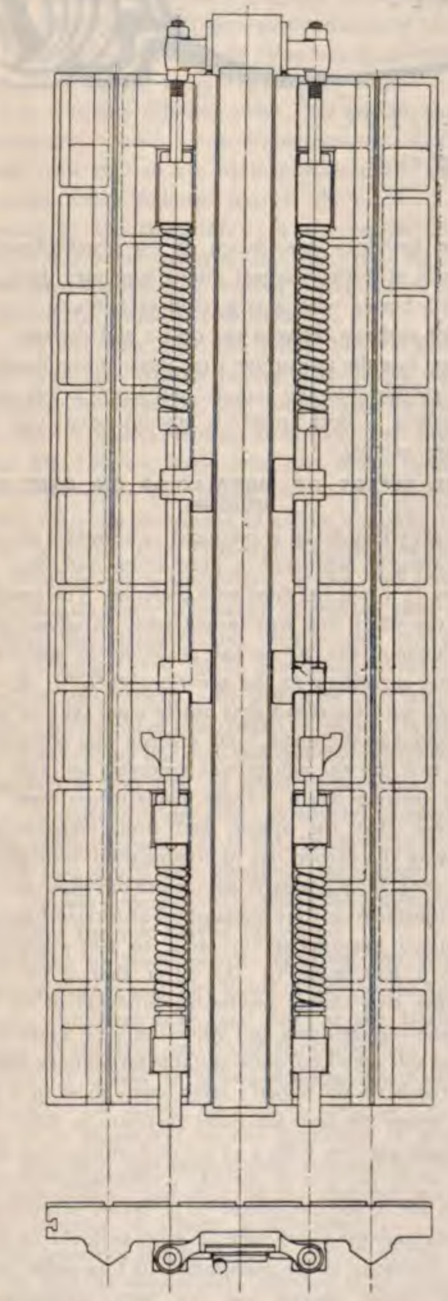
The clutch in action, cutting to full lines; out of action, returning to chain dot lines.

The standard type of planer is fitted with brackets on housings to carry either the countershaft or the countershaft and motor combined. Machines of this kind are entirely self-contained, and can be placed anywhere in a shop; the centres of the belt pulleys and the countershaft pulleys are also thus kept well proportioned, and the countershaft bearings are so designed that any stretch that takes place in the belts can be readily adjusted.

An important point is the introduction of patent fly-wheel loose pulleys for use with overlapping belt, and with automatic friction clutch between the fly-wheel and fast pulley, of which there is one on either side of the machine for cut and return.

The action of the clutch is briefly as follows: The rod A, which is actuated by the belt-shifting arrangement, moves the vertical shaft B, at the bottom of which is keyed a small pinion D, gearing into short rack cut on slide bush E, which is free to move along the pulley shaft F. Attached to the inner edge of the slide bush E are segments of gripping ring G, working in recess on the boss of flywheel loose pulley H. Between the end of the boss of flywheel pulley and the end of slide bush is a ball thrust bearing. The flywheel loose pulley H is also free to move along its shaft, and it will be seen that any motion given to rod A is transmitted into the flywheel, and either moves it so that the friction clutch J is brought into or out of action. This motion is so timed to take place when the belt is thrown on or off the fixed pulley, and, together with an overlapping of the belt from the fixed on to the flywheel pulley, enables the conserved energy of the flywheel to be transmitted into the fixed pulley at a moment when a large amount of power is required on such machines, owing to the sudden reversal of the moving parts.

It would not be possible to run the ordinary planer at such high speeds without a very excessive use of power at the moment of reversal, were it not for some such means as above described, and also if this were attempted, the effects in the other parts of the machine would be serious, as the shock and jar of the reversal would inevitably break the gearing. This trouble is overcome by fitting the cushion springs (referred to above) under the table, so that the drive is transmitted through the gearing on to the rack, which has a free slide motion along the length of the table, and transmits the motion received through cross head at the end, and through the springs on to the fixed bosses or lugs on the table.



PLAN OF UNDER-SIDE OF HIGH-SPEED PLANER-TABLE. SHOWING ARRANGEMENT OF SPRINGS.

It will be seen, by referring to the drawing, that one set of springs acts on the reversal from cut to return, and the other set on the reversal from the return to the cut. this being accomplished by connecting up with the compression rods. The springs are adjustable, so that no more motion than is required takes place, while on the cut there is a metal to metal pressure, and the drive is not transmitted through the springs.

Electric Power Scheme for London.

Considerable interest attaches to a bill which is being introduced this Session with the comprehensive title "Administrative County of London and District Electric Supply Company." Powers are sought under the bill for the purpose of enabling a supply of current to be given to existing authorities, the latter to have the option of continuing to distribute it to light and power users. The maximum charges under the bill range from 1½d. to ⅞d. per unit, and the dividend of the new company is to be on the sliding scale system adopted by gas companies, the standard rate being 8 per cent., with an additional 1 per cent. for every 5 per cent. reduction made in the price of current. The powers sought for cover two areas, the East End of London, with its manufacturing districts, and a Western area. Should this scheme be carried out, it is stated that it would mean a considerable cheapening of the cost of electrical power in London. The latest Board of Trade returns available, those for 1903–4, show the average price of electric current in London to be 3·57d. per unit, and cost of production a fraction over 2d. per unit. The company will have a capital of £5,000,000, and among those associated with this important enterprise are Lord Armstrong, Sir James Joicey, Bart., M.P., Sir Andrew Noble, the Right Hon. Sir G. D. Taubman Goldie, Sir Thomas Richardson, M.P., Sir Lindsay Wood, Mr. Douglas Vickers, Mr. P. Wigham Richardson, and Mr. A. F. Yarrow,

SCIENCE IN THE IRON FOUNDRY.

BY J. E. STEAD, F.R.S., F.I.C.

(*Continued from page 422.*)

SAMPLING PIG IRON FOR ANALYSIS.

WHEN a consignment of pig-iron arrives at the works, before taking any sample, note should be made whether or not the metal in the trucks is apparently regular or of mixed quality. If regular, two or three pigs off each truck should be selected. If irregular a larger number. These should be broken and note taken of their fracture number. Drillings should be taken from the side, half-way between the bottom and top of the pigs. After the drill has penetrated ⅛ of an inch below the skin, what is removed in this way should be rejected, and the drill then bored to the centre, and the clean drillings reserved for analysis. The drillings from the several pigs should be mixed in equal proportion, and the mixed sample should be thoroughly cleansed with a magnet to eliminate any grains of sand which may have accidentally fallen into it.

The importance of taking drillings from the position given will be recognised when it is known that the sulphur is always much higher at the top than at the bottom of the pigs. Indeed, I have found three or four times as much in the upper layer as was present in the bottom layer. Mr. Guy Johnson, in one of his trials, found an average of 0·024 per cent. in the lower part, 0·108 per cent. in the central portion, and 0·148 per cent. in the upper layer, the centre portion approximating to the average. The more manganese present in the pig the greater is the flotation of the sulphide of manganese at the top.

It will be readily conceived that in consequence of the property of the sulphur compound to float off, the metal which runs into the pig moulds should have less sulphur than the same material when it leaves the furnace. This is actually the case, and the difference is usually the greater when the amount of manganese present is larger. I have met with scum on the surface of basic pig which contained 5 per cent. sulphur.

The American Association for the standardisation of methods of testing suggest taking four pigs from every car and boring with a large drill each fractured end at a point midway between the centre and the side. This method has the advantage that there is less liability of sand getting into the sample, and there is less trouble in drilling. Both methods should give the same average sample.

THE EFFECT OF METALLOIDS ON CAST-IRON SILICON.

In 1875 I made an experiment to ascertain the effect of heating to whiteness a pure white iron, free from silicon, in a crucible lined with ganister. The result was that the white iron was turned grey. Analysis proved that some of the carbon had acted on the silica of the ganister according to the equation—$SiO_2 + 2C = Si + 2CO$, with the result that nearly 1 per cent. of silicon was found in the metal. On melting this metal with a little iron ore the silicon was removed and the metal again became white. These experiments were clear evidence that the silicon had been responsible for throwing the carbon out of combination with the iron.

In 1885, Mr. Charles Wood, one of our most esteemed Past Presidents of the Cleveland Institution of Engineers, conducted experiments in order to test a statement which I had made to the effect that if he melted together two almost unsaleable products of his blast furnaces—glazed iron and white iron—he would obtain a good soft grey iron, quite suitable for foundry castings. The result of Mr. Wood's trials were given in a paper read before the Iron and Steel Institute in 1885.

Glazed pig iron with 4·43 per cent. silicon was melted with white pig iron in varying proportions, with results which Mr. Wood considered to be rather surprising, for the castings produced were as good as could be wished for. Previous to the publication of this paper the rôle which silicon played had not been understood in England. Professor Turner had, however, three months previously shown in a paper read before the Chemical

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Read before the Cleveland Institution of Engineers.

Society that the addition of ferro-silicon to pure cast iron, practically free from sulphur, or a compound of iron and carbon alone, increased its tenacity.

In 1886 Mr. Fred Gautier, Paris, in a paper on "Silicon in Foundry Iron," read before the Iron and Steel Institute, stated that the experiments just referre to proving that white pig iron with a suitable addition of silicon would give grey castings of the best quality, offered an entirely new departure in metallurgy, the practice of the most experienced founders being based on a totally different view. He also stated that in his opinion "this discovery is perhaps even more important than that of the basic process itself, and the discussion which followed upon it did not seem to me adequate to the importance of the subject." The so-called discovery referred to was the fact that silicon acted indirectly in causing the combined carbon to assume the graphitic condition.

It was not long after the publication of Professor Turner and Mr. Wood's papers that glazed pig iron previously unmarketable, was sought after by founders and a great demand sprang up for ferro-silicon. Although it was Mr. Charles Wood who first made trials on a commercial scale by mixing silicon pig and white pig iron with the production of a grey mixture, it must not be forgotten that Professor Akerman, of Sweden, had, thirteen years previously, shown the tendency of silicon and combined carbon to replace each other, and that had founders and others read his papers with intelligence they might have made advantageous use of his observations. Dr. Percy, in his work on iron and steel, published in 1864, page 131, says: "It has long been observed, in the first instance by Sefstrom, that the carbon in grey iron, in which much silicon exists, say 2 per cent. to 3 per cent., is wholly, or nearly so, on the graphitic state. It is not, however, to be hence inferred that silicon has displaced the carbon," from which it would appear that Dr. Percy did not thoroughly understand the rôle played by silicon.

Referring to the remarks regarding the work of Professor Turner and Mr. Wood, Professor Ledebur in a paper published later, and read at the Darlington meeting of the Iron and Steel Institute, says: "The presence of silicon in pig iron consequently diminishes its capacity for taking up carbon, and, on the other hand, it is necessary for the formation of grey pig iron. Pig iron, free from silicon, remains white even after slow cooling, and grey pig iron changes into white if its contents of silicon is abstracted. . . . . From this the deduction follows directly, that if molten white pig iron has the opportunity afforded it of taking up silicon, it will change into grey pig iron."

It would appear then that both Professor Akerman and Professor Ledebur have the credit of having previously published the exact rôle which silicon plays in cast-iron, but it must be remembered that neither of the gentlemen had suggested the mixing of silicon pig with white iron. Indeed, Professor Turner, in his work on the metallurgy of iron (1900), page 196, says: "The practical application of silicon in the foundry is due chiefly to Mr. C. Wood, Middlesbrough, who was working in this direction with Mr. Stead in 1885.

It is well known by pig iron manufacturers that grey pigs with the lowest percentage of silicon are the most difficult to break, and a fair idea of what amount of silicon is present may be formed by watching the breaking of the pigs. No. 1, 2, 3, Hematite pigs with 1·5 per cent. silicon are only broken with difficulty; with 2·5 per cent. silicon, more easily, and with 3 per cent. silicon and above, very easily. It will be understood then that silicon directly weakens iron and makes it less resistant to shock.

Glazed pig iron contains high silicon. The peculiar glazy appearance of the fracture is due to the cleavage faces of the metallic matrix, which are not seen in pigs containing little silicon, for the track of the fracture when the matrix is strong is mainly through the cleavages of the plates or curved sheets of graphite. The cleavages of the matrix are white, whilst those of graphite are black.

Silicon has a much stronger attraction for iron than carbon, a fact easily proved by melting white Swedish iron with 20 per cent. silicon in a closed graphite crucible. The whole of the carbon will be expelled and float to the surface of the metal. The white metal remaining will be silicide of iron, free from carbon. I believe it was Mr. Edward Riley who first discovered that metal with 20 per cent. silicon contains no carbon and is quite white. Iron containing 4 per cent. silicon cannot be carburised by the cementation process. It is necessary to have a melting heat before carbon will pass into such iron, and at the point of solidification what is absorbed will be thrown out of solution, and no combined carbon will remain in the cold metal.

Valuable papers on silicon and iron have recently been published by M. Guillet and another by Mr. Baker, which should be carefully studied by every metallurgist.

EFFECT OF SULPHUR.

The direct effect of sulphur on the strength of cast iron has long been regarded as injurious, but no reliable experiments have been carried out to determine the truth of this in Europe. Indeed, the only trials made on correct principles, so far as I know, are those of Mr. Guy Johnson and Mr. Keep, both Americans. As will be seen, the evidence appears to show that provided sulphur does not keep the carbon from separating as graphite, even 0·15 per cent. has very little effect, if any, on the strength of the metal. In the experiments conducted by Mr. Wood the presence of 0·16 per cent. sulphur did not appear to be harmful.

In Mr. Johnson's trials the only direct effect appeared to be that of making a closer grain, and consequently a stronger casting. Its effect, however, indirectly is undoubted, for unless the silicon is fairly high it prevents the separation of graphite, and a hard iron is the result. It follows, therefore, that when making the strongest iron castings the silicon should be low and the sulphur very low. The good quality of cold blast iron is undoubtedly due chiefly to the association of a low silicon and sulphur content.

Chemical examination has shown that when the manganese reaches or exceeds 0·50 per cent. the sulphur exists mainly as sulphide of manganese. This separates out before the metal becomes solid, and owing to its low specific gravity, begins to float upwards, and some of it eventually escapes out of the metal, but if the surface metal solidifies in advance, the elimination of the sulphide of manganese cannot occur, and it is mechanically held in the upper layer of metal. This is the reason why pigs contain more sulphur at the top than at the bottom.

Once the sulphide of manganese has separated independently, it no longer exerts any influence on the carbon condition, even although it may be enclosed in the metal. In proof of this I possess a piece of a large grey cast-iron, broken from the upper end of an ingot mould, which contains 1 per cent. sulphur as sulphide of manganese, and yet there is no combined carbon present. The original metal contained about 0·90 per cent. manganese, and 0·07 per cent. sulphur.

Mr. Andrew Blair, of Boston, U.S.A., found sulphide of titanium in very grey pig iron in the form of idiomorphic crystals, which had the following compositions:

Titanium	62·82	per cent.
Iron	1·82	,,
Carbon	9·82	,,
Sulphur	22·64	,,
	97·10	,,

When little manganese is present, some of the sulphur most probably exists in the form of iron sulphide.

There can be no doubt that whether it exists as sulphide of iron or sulphide of manganese, each substance has the physical properties of scoria, and the presence of scoria from the purely mechanical point of view cannot be regarded as beneficial.

It will be observed on examining the specifications of the American founders that sulphur above 0·085 per cent. is not allowed in anything excepting special hard iron such as that required for brake shoes, etc.

Whilst admitting the advisability of using irons with as low sulphur as possible for the strongest small castings, yet in larger sections and masses there can be no doubt that sulphur may be higher without great disadvantage; indeed, the best Staffordshire chilled rolls contain 0·17 per cent. sulphur.

EFFECT OF CARBON.

The combined carbon is mainly the determining factor of the hardness and shrinkage of a casting. The conclusions of Professor Howe, that the strongest iron is that in which the metallic matrix is pearlite with no massive carbide of iron, appears to me to be perfectly sound, but that excepting in the case where there is little or no phosphorus there is almost always some massive carbide present if the combined carbon reaches 0·90 per cent. for the simple reason that, as in Cleveland iron, the phosphorus unites with a considerable proportion of the iron which, separating out as a eutectic, leaves less free iron capable of existing in the eutectoid pearlite. Probably 0·70 per cent. is the highest amount admissible for such iron with good machining properties.

For general engineering foundry castings about 0·50 per cent. is a fair amount.

The total carbon should not exceed 3·25 per cent. either in soft or hard castings.

In the average irons available in this district it runs between 3·30 per cent. and 4·20 per cent., the higher figure representing that in low silicon grey hematites.

Professor Howe considers air-furnace melting preferable to cupola melting on account of some of the carbon being burnt out in the air furnace, but the same object can be gained by the judicious use of steel scrap in the cupola furnace. Bessemer steel scrap when melted alone in a very hot cupola absorbs about 3 per cent. carbon, but, if melted with pig iron high in carbon, little carbon passes into it. Indeed, when melting 80 per cent. pig, with 3·75 per cent. carbon, and 20 per cent. scrap, with 0·35 per cent. carbon, the melted iron will contain about 3·25 per cent. carbon. That is to say, the steel only absorbs under such conditions about 0·75 per cent. carbon.

The quantity of steel admissible must depend upon the other elements present in the iron, and on the size of the casting. To put a large dose of steel into a metal low in silicon and carbon and high in sulphur would make the iron white, but when the iron is sufficiently high in silicon and low in sulpl
quantity of steel can be employed.

The conditions favourable for the use of steel can only be determined by the assistance of chemical analyses of the pig irons which have to be melted with it.

The reason why high carbon in the graphitic state is objectionable, is on account of the fact that every plate of graphite mechanically breaks the continuity of the metallic matrix, and the fewer of such breaks, within reasonable limits, the more coherent is the mass.

The great value of steel scrap has been fully proved by many founders in America, and also in some works in our own country.

EFFECT OF MANGANESE.

The manganese in English and Scotch irons is generally higher than in those of American origin. Founders in this country have always regarded Scotch brands as the very best obtainable, and these are peculiar by containing much higher manganese than allowed by American founders. In my own experience manganese strengthens the iron and if it does not exceed 1·20 per cent. may be advantageous, indeed, it appears to effect the removal of a small quantity of sulphur or prevents that element from being retained from the coke in the cupola. The experience in America, however, proves that good castings of high quality may contain very little, and it is questionable whether, or not, a slight increase in the combined carbon will not be equivalent to a decrease in the manganese.

EFFECT OF PHOSPHORUS.

The phosphorus exists in pig iron in the form of phosphide of iron (Fe_3P). It separates out and is the last to freeze when iron containing it solidifies. The actual amount corresponding to—

0·5 per cent. phosphorus	..	3·22 per cent. (Fe_3P)
1·0 ,, ,,	..	6·45 ,,
1·5 ,, ,,	..	9·67 ,,

This phosphide forms a fusible complex eutectic with a portion of the iron and its associated silicon and carbon in the cast iron. Its composition varies with the analysis of the iron. When partially solidified iron is compressed, this eutectic, associated with some of the iron, can be squeezed out of it. On treating Cleveland grey pig in this way I succeeded in obtaining a fusible mixture containing above 5 per cent. phosphorus.

The microscope shows that this eutectic exists in isolated patches, embedded in the centre of the masses of metallic matrix, which latter are bounded by the sheets of graphite. They rarely, if ever, join together or form continuous bands, and, as a rule, do not come in contact with the graphite plates. This eutectic is hard and brittle but not so hard as carbide of iron. When in a separate and massive state it is too hard to drill, but can be crushed to a powder in a steel mortar.

As the phosphorus increases the ralative mass of eutectic also proportionately increases. When 2 per cent. is present the phosphide is nearly 20 per cent., and the separate particles sometimes join together to form lines or planes of weakness. As a consequence such metal is very tender. In proportion to the increase of phsophorus the metallic matrix becomes weaker and weaker, the plane of fracture becomes more even and the iron does not tear in breaking but snaps suddenly.

The closer the grain of grey iron the greater the number of the isolated particles of the phosphide eutectic. Phosphorus does not have any influence on the carbon condition unless the quantity is very great when it appears to favour some of the carbon existing, in the combined condition. It does not appear to influence the chill, excepting perhaps to make a defined sharp division between the chilled and unchilled portion. It is believed to decrease the shrinkage, but it is probable that although test bars do apparently indicate that such is the case, the apparent non-shrinkage in a longitudinal direction may be more than compensated for by shrinkage in other directions, due to the peculiar plastic character phosphorus gives to iron below the point of primary solidification. More research is required in this direction.

PRACTICAL SUGGESTIONS.

To those who wish for the introduction of scientific methods into their foundries, the following points should be remembered :—

An analyst who has no metallurgical knowledge is only useful for supplying true analyses, but in that respect he is indispensable.

Foundries rarely have fully trained metallurgists to control the mixing and casting of metals.

If there is a metallurgist in the foundry he will be able to usefully apply the analyses provided by the analyst.

The primary essential is to have accurate analyses, and in making a selection a chemist should be chosen who has had a metallurgical training in a technical college, or a full course of City and Guilds or other equally good series of lectures on the metallurgy of iron and steel, or who, by private study, has fully qualified himself. It is a rare thing to find a chemist, who has had practical experience in a foundry, and the founder must take the material available. Having selected a man, his real training must begin on entering the foundry laboratory, and whether or not he develops into a useful metallurgist must largely depend upon his ability and capacity for gaining knowledge.

One of his duties should be to read everything published on foundry work, and to ensure that he does this he should supply periodically to the head or principal a review of the publications. He should ascertain the best chemical composition for any particular class of work, and castings which have given maximum good service should be obtained and analysed. All castings which have gained a high reputation should be tested, and portions of castings which have failed should likewise be analysed. In this way real knowledge will be obtained, and a solid foundation laid, for he will know what to aim at and what to avoid.

It may be accepted as a general rule that the value of any average brand depends upon its composition, that is to say, if a mixture of several brands has the same composition as that of any other brand, the metal will have the mechanical properties of that brand. For instance, it is easy to make a mixture from irons in this district which will have all the good properties of any of the Scotch brands.

If the output of a foundry does not justify the employment of a metallurgical analyst, the makers of pig iron should be asked to provide analyses with each delivery to an approximate specification, and if an extra price is demanded for this, say sixpence to a shiling per ton, it should be paid. They will be worth it.

Some owners of foundries have informed me that they would have great difficulty in introducing analytical control into their works owing to the prejudices of the foremen. Of the foremen who hold such prejudices it may be said that they are working with their left hand only. If they themselves, would demand analyses they would then be able to work with their right hand also. An analytical metallurgist in their works would be found as valuable in the conduct of the establishment as the secretary, accountant, or the timekeeper.

CONCLUSIONS.

I have sought to bring to a focus the experience of those who have applied their attention to the application of science to cast-iron foundry practice, and have endeavoured to outline a system for those who have not as yet seen the necessity for working on scientific lines, but who, in the natural order of things, will eventually find it to their advantage to do so. I have, however, just touched on the fringe of the subject. The influence of correct casting temperature on the properties of the iron, the management of the cupola and air furnaces, the best composition for moulding sand, etc., have not been discussed, but in these directions science can be and has been brought to bear. I can fittingly close by quoting a statement made by Mr. Moldenke, in a paper on the physics of cast-iron read before the American Institution of Mining Engineers in February, 1904, who says: "The American founder has come to realise that the chemical specification alone is the best safeguard" and that "in dollars and cents, the benefit of science to the much neglected foundry industry in America has been incalculable."

LAUNCHES.

The Countess Fitzwilliam gracefully performed the ceremony of naming the fine large twin-screw steamer *Aragon*, launched from the yard of Messrs. Harland and Wolff, Ltd., on the 23rd instant. This steamer marks an epoch in the history of the R.M.S.P. Company, one of the oldest and now recognised as one of the most progressive of British Steamship lines. In addition to being the finest vessel in the R.M.S.P. fleet the *Aragon* will be the largest steamer engaged in the South American trade. Her dimensions are: length 527 ft. 6 in., beam 60 ft., with a gross register of about 10,000 tons. The *Aragon* is designed to carry a large quantity of cargo, but passenger accommodation on the most sumptuous scale is her speciality. She is fitted with Messrs. Harland and Wolff's latest "Balanced" quadruple type of engines.

There was launched from the shipyard of Messrs. Cochrane and Sons, shipbuilders, Selby, on Wednesday, the 22nd ult., a handsomely modelled steel screw trawler, the principal dimensions being 123 ft. 6 in., by 22 ft. by 11 ft. 6 in. depth of hold. The vessel has been built to the order of the Grimsby Union Steam Fishing Company, Ltd. (Messrs. Letten Bros.), Grimsby, and is being fitted with powerful triple expansion engines by Messrs. Charles D. Holmes and Co., Hull.

Messrs. W. J. Tatem and Co., of Cardiff, have launched, from the Pallion Yard of Messrs. William Doxford and Sons, Ltd., another large turret steamer, the s.s. *Wellington*, designed to carry 9,000 tons deadweight. Although the *Wellington* was the first vessel of this type contracted for at Cardiff several of these turret steamers have already been completed, and others are in hand, for Cardiff owners.

APPLICATION OF ELECTRICITY TO INDUSTRIAL PURPOSES.

A paper on this subject was read before the North-East Coast Institution of Engineers and Shipbuilders by Mr. J. F. C. Snell, M.Inst.C.E., on Friday last.

The following is an abstract of the paper :—

The author said that in this connection there were important points to be considered, such as the comparative economy between installations (for the driving of machine tools) laid down at the works themselves, and the purchase of electricity from an outside power station owned by either a separate company or by the municipality, and the comparative advantages of direct current and alternating polyphase currents. The managers of works had also to consider their position electrically, with respect to the Board of Trade and the Home Office, and there was in addition the importance and economy of standardisation to be considered.

Through the kindness of members of the Institution referred to above the author is able to record the actual results of electrical stations owned by two large shipyards, one of which is being partly driven by its own steam-driven plant, and partly from a town supply, these two systems being entirely separate from one another. The other example is that of a shipyard supplied from its own gas-engine-driven generating plant. In these two examples there is a variation in cost per unit frcm separately driven plant of respectable dimensions from 1·08d. to 1·173d. The author has always contended that in works requiring from 300,000 to, say, 1,000,000 units per annum, and with a load factor of 20 to 30 per cent., the cost will be found to vary from 1·25d. per unit to 1d. ; and he is of opinion that, looking at the question broadly and taking into due account an adequate depreciation of plant and average cost of upkeep for, say, a period of twenty years, 1d. is about the lowest limit for installations of the size stated. There are special cases, of course, in which, either through an abnormal and excellent load factor, or through the utilisation of blast-furnace gases, the cost is materially reduced blow this figure. These, however, are quite the exceptions.

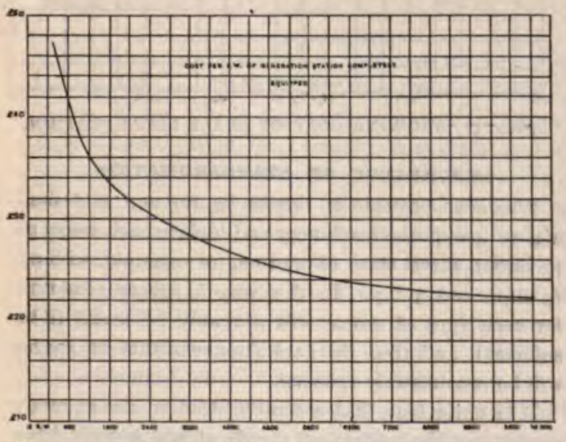


FIG. 1. CURVE SHOWING RELATION OF COST PER K.W. BETWEEN STATIONS OF VARYING CAPACITY.

SUPPLY FROM OUTSIDE SOURCES.

Turn to the other side of the question, viz., supply to works from outside sources. The first and most obvious saving is in the capital outlay per kilowatt. The following curve gives the relation of the cost per kilowatt (one kilowatt=1⅓ h.p.) between stations varying from 250 kilowatts up to 10,000 kilowatts.

Secondly, it must be equally obvious that, while a decent load factor of anything between 15 and 35 per cent. even may be obtained in an independent installation, yet the combination of a dozen and, *à fortiori*, several dozen such works in one station must result in a far better load factor, which is actually in practice found to be anything from 45 to 55 per cent. This improved load factor at the resultant station due to the non-synchronism of the various maximum demands on the several works is known as the "diversity factor." This diversity factor really has a high value. The author knows examples where the resultant maximum load at a generating station is only some 60 per cent. of the integrated total of the maxima. This, obviously, means that a given amount of plant installed at the power station is able to deal with a much larger total of horsepower of motors installed in various works than the same plant could possibly deal with if it were split up into a number of small independent installations.

The scale of prices upon which a power station may be reasonably expected to supply current is shown in the accompanying diagram (fig. 2). This scale is based upon the practical capital cost of a large power station equipped with modern appliances, and the remaining figures of fuel, stores, wages and other establishment charges, are taken from actual practical results.

Reference to fig. 3, which deals with the cost of a small local station installed for the supply of large works, demonstrates at once the influence of the capital cost upon the units generated, and the economy which can be obtained from the concentration of many such small installations in one big power station, and even this does not account for the important detail already referred to, viz., the "diversity factor." From these two diagrams it will be possible for any director of works to see the relative costs for his particular factory which will result from either the town main or his own plant.

ADVANTAGES OF DIRECT AND ALTERNATING CURRENT.

The advantages of the direct current are: variation of speed over a considerable range, without undue loss of economy, and with utmost simplicity; and in favour of the three-phase motor, the utmost simplicity of mechanical and electrical construction, the total enclosure of the motor, and absence of commutator and of any wearing parts other than the bearings, which are themselves negligible.

The costs and weights of motors are in favour of the three-phase type, and the only objection which one can offer to the three-phase motor is its less easy variation in speed when compared with its direct current competitor. On the whole, the author is of opinion that the simple three-phase induction motor is much more likely to gain favour than even its quite simple direct current rival. In point of efficiency the direct current motor has the advantage at present and is probably, from physical reasons, likely to continue to have the advantage.

The judicious grouping of motors or application of single motors to special tools, and the relation of their initial capital cost to the general working expenses after their installation, is in many works a complicated problem, upon which it is submitted only one who has made a special study of such applications is competent to advise. It would be unfair to the general industries of the country if, when called upon to make the necessarily great sacrifices in scrapping their original methods or driving, and substituting a more efficient electrical motor, every care were not taken to adopt at once the most economical method in outlay, and the most efficient in practice afterwards.

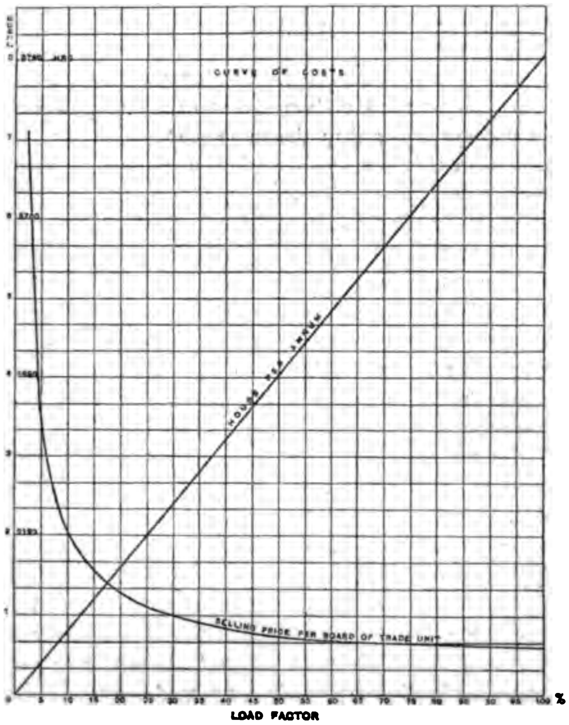


FIG. 2. CURVE OF COSTS.

The adverse criticism which occasionally falls upon electrical driving, in the author's opinion, creates a real demand for the consultation experts at the present juncture, when the tendency is so much towards the adoption of electricity as the driving agent.

The author points out that the regulations which are being imposed upon electrical users are somewhat confusing and complicated to the uninitiated.

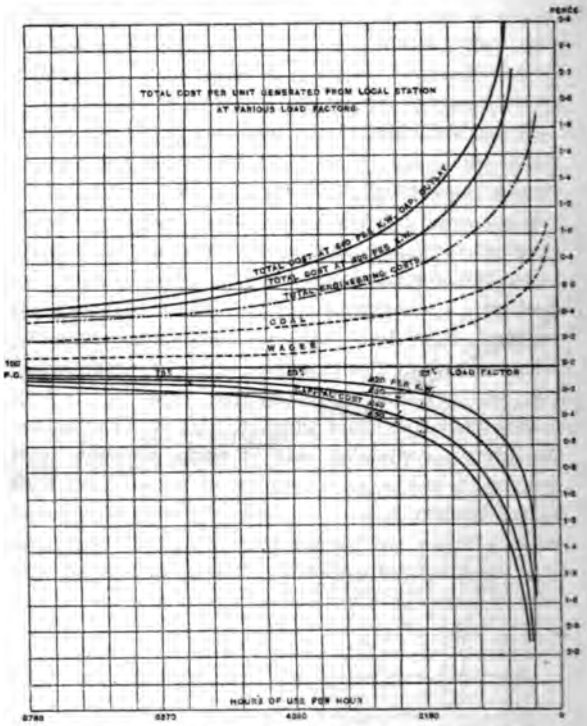


FIG. 3. SHOWING COST OF SMALL LOCAL STATION.

IMPORTANCE OF STANDARDISATION.

Wherever possible it should be the aim, in designing, to group the machinery and tools in such a way as to adopt three sizes of motors, for example, 30 h.p., 15 h.p., and 5 h.p. In this way a square armature for each type of motor will probably be found to be sufficient, and thus the capital expenditure on spares will be considerably reduced.

It is quite true that a complication ensues in many cases from the variety of speeds at which to to be driven, but the author does not as bad as is made out, and in special cases, rather than instal a fourth size of motor, he would be inclined to modify the speed through gearing of some kind, even at the risk of some loss in efficiency. Then, the starting switches, the switchboard panels and instruments could be made, say, of two sizes to suit the three classes of motor, and thus there will be some system instead of the too frequent and too great variety of instruments one sees installed. In a system carefully laid out, the cables can also probably be arranged to be covered by two sections. The arc lamps should be, if possible, of the same pattern, and the resistance of choking coils in connection with them should be of precisely the same pattern. Thus a very simple and easily understood system will be adopted with a resultant minimum first cost.

TECHNICAL SOCIETY NOTES.

Everybody being agreed that overhead mains are desirable by reason of their low comparative cost, Mr. Addenbrooke's paper on the subject which was discussed at the last meeting of the Institution of Electrical Engineers found each speaker taking the affirmative. It fell to Mr. John Gavey, of the Post Office, to open the debate. He noted that Mr. Addenbrooke's figures only made provision for three wires, and he doubted whether that number would suffice. Another point to be noted was that three-phase transmission on open wires caused a good deal of inductive disturbance, and he was afraid that the carrying of overhead wires along main roads in the neighbourhood of telegraph and telephone wires would set up such disturbance. At the same time he admitted the difficulty of obtaining private way-leaves.

Mr. R. S. Portheim rather controverted this view, stating that his firm, which was associated with a North Wales Power Company, absolutely dependent on overhead mains for commercial success, had experienced little or no difficulty in regard to way-leaves for a 10,000 volt system. Private owners had been reasonable, and the same might be said of the Board of Trade. Mr. C. P. Sparkes had also a good word to say for the Board of Trade, and he reproached Mr. Addenbrooke for his attack on that Department. Local Authorities and not the Board of Trade were the stumbling block in country districts, and he was of opinion that the solution of the way-leave difficulty was to work along main roads other than those used by the Post Office for their wires.

Mr. Kensit gave it as his experience that the average cost of private way-leaves was about £20 per mile per annum. Another critic regretted that he had not had the same happy experience in respect to way-leaves as Mr. Portheim. Much was often made of the dangers arising from the breaking of overhead wires carrying high-tension currents, but his experience showed these fears to be groundless. Mr. Pooley thought that whatever might happen in country districts it would be necessary to feed underground in town, and therefore with an extension of the overhead system in this country, cable makers, instead of regarding it as a rival might look upon such a system as the opening up of a fresh field of enterprise.

Mr. Addenbrooke had really little to answer in the way of criticism, but with regard to the Board of Trade, whilst acquitting the electrical officials of that Department from all blame, he stoutly maintained his ground, definitely referring to "stubborn resistance," and darkening the air of the hall with dreadful hints of what he knew. Finally, coming to something more technical, he said that the use of spans up to 150 yards. for overhead mains would further cheapen the cost.

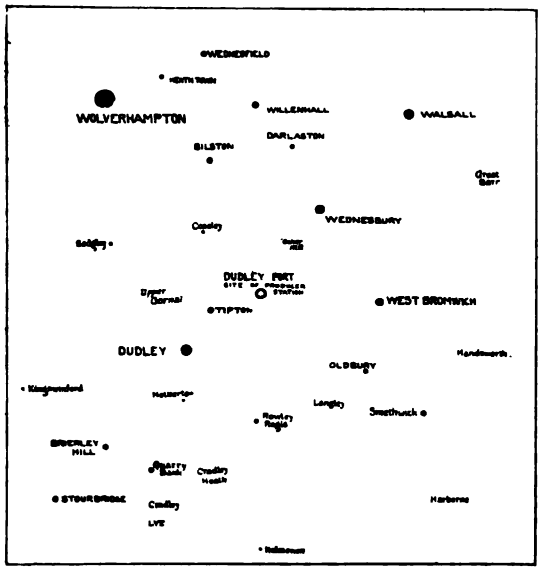
An interesting paper on "Engineering Expert Evidence," contributed by Mr. James F. Reade, was read at a meeting of the Civil and Mechanical Engineers Society yesterday. The expert's position when giving evidence is, the author pointed out, somewhat peculiar. He is, to some extent, an advocate, but without the freedom enjoyed by a legal advocate. Counsel is not expected to be impartial; on the contrary, it is his duty to seize upon and make the most of every point in his client's favour, and minimise everything which may be pleaded against him. An expert is also expected to do this, but in a minor and less obvious degree. The best witness is he who disguises this portion of his functions most effectively, and while appearing to be impartial, is merely making a strong case for his employer, or cutting under the foundations upon which the opponents' case stands. Here is an ideal for expert witnesses.

The author of the paper to be read at the meeting of the Society of Engineers on Monday next is Mr. Benjamin H. Thwaite, and the subject: "The Transport Possibilities of our Inland Navigation." It is an important problem, and it will be surprising if Mr. Thwaite does not make a notable addition to the literature of the subject.

Power Gas Distribution from Dudley Port.

THE completion of the first unit of the Mond gas producer plant, erected at Dudley Port by the South Staffordshire Mond-Gas Company, for the supply of gas to consumers in the district, marks an important stage in power development, and will be watched with much interest by engineers in other parts of the country. It is certainly worthy of careful attention, whether from the point of view of the manufacturer, anxious to reduce the cost of running his machinery, the colliery manager dealing with the difficult problem of small coal, or those who are directly concerned in the development of the gas engine.

The company were authorised by Act of Pariament to acquire seven sites, aggregating 134 acres, on which to establish works. The site finally selected for the first manufacturing station is at Dudley Port, and there a plant has now been erected. The site at Dudley Port extends to about 40 acres, and is designed to ultimately contain four complete units, each capable of producing 1,000,000 cubic feet of gas per hour. So far, however, only one unit has been erected, and our contemporary, the Gas World reports that this is now standing in readiness for the completion of the laying of the distribution mains, which work is expected to be finished in a few weeks' time.



'DUDLEY PORT IN RELATION TO THE NEIGHBOURING TOWNS.

The leading main from the manufacturing station is 36 in. in diameter, and this is led to Ocker Hill, where it branches off into two 30 in. mains, one leading through Bilston to Wolverhampton and the other through Wednesbury to Walsall. These are again sub-divided and reduced as they proceed. The compressing plant at the station has been designed to send the gas out at an initial pressure of 7 lb. per square inch. As there is no storage for gas beyond what is provided by the mains, it became essential to provide some automatic means of regulating the supply to the demand, and this, we are told, has been successfully done. Indeed, the whole installation has been designed in such a manner as to reduce human labour to what may be called an irreducible minimum.

Both station meters and consumers' meters are of the Thorp rotary type. The station meters are each capable of passing 500,000 cubic feet of gas per hour. The capacity of the consumers' meters will, of course, vary with the requirements of individual customers.

DETAILS OF THE PLANT.

It was recently pointed out when the Junior Engineers paid a visit to this station that it occupies a position which is practically the industrial centre of gravity of the district. The following is the description in brief which was furnished on this occasion : The first central station has been designed for four units, each of eight producers, and the first unit is now erected together with a complete set of spare towers. Each producer is capable of gasifying one ton of coal per hour throughout the day and night. The central station is well supplied with railway and canal facilities for the cheap handling of the coal, and it is expected to use the common slack of the district, most of which will arrive by canal boats. The coal elevators, storage bunkers, producers, superheaters, gas mains, mechanical washers, and towers, all stand in the open, and can be readily inspected.

In the lead acid towers the gas meets a down-flowing stream of acid liquor which absorbs the ammonia contained in the gas, forming sulphate of ammonia, which is afterwards converted into the marketable crystals of this material in a separate brick building known as the sulphate plant. The iron towers serve the purpose of cooling the gas and condensing the steam contained in the gas when it leaves the producers for heating and saturating the air blast on its way to the producers, and for cooling the water required for the final lowering of the temperature of the gas. It should be noticed that the hot water obtained from the towers in which the gas is cooled is made use of in the air tower for heating the blast and saturating the steam.

The main building is divided into the boiler house, the machinery house, and the pump house. Steam is raised by means of "Climax" tubular boilers arranged for burning small coal with forced draught, and also for firing by gas. The two systems can be used simultaneously or separately. In the machinery house will be found the Fraser and Chalmers' Compressors required to put the gas under pressure for distribution, also the two vertical Westinghouse gas engines for supplying power for the various electric motors used in connection with the plant, and for lighting purposes.

The pump room contains the necessary pumps for circulating hot and cold water and acid liquor through the various towers, also the blowing sets for supplying air under pressure to the producers, and, lastly, the rotary purifying apparatus for the final treatment of the gas. The floor of the buildings is of the granolithic type, being of concrete and steel, and beneath it is a basement traversed by the various pipes required to connect the different pieces of plant. This arrangement gives a clear floor space, and obviates the usual unsightly crowding of pipes overhead.

The separate buildings are the sulphate plant, meter-testing house, oil stores, workshop stores and offices. The small gasometer which may be noticed is not connected with any storage of producer gas, but is for the accurate testing of the rotary meters to be used on the distribution system.

The pipes for conveying the gas to Wolverhampton, Walsall, and intermediate towns, have now been laid. They are mostly of the steel locking-bar type, manufactured by Mephan Ferguson, and all tested to 300 lb. per square inch before laying. A special form of steel screwed pipe has been adopted for the branch mains.

The accompanying sketch map will serve to show the importance of the district and the admirable situation of the new plant both as regards proximity to the coal pits and to manufacturing towns.

PARLIAMENTARY POWERS.

The South Staffordshire Mond-Gas (Power and Heating) Company's Act, under which the scheme has come into force, was passed in 1901. The first directors of the Company were Joseph Bramah Cochrane, Gilbert Henry Claughton, Sir Benjamin Hingley, Bart., Edmund Howe, George McPherson, Ludwig Mond, and two others. It gives the Company power to acquire lands and to lay mains under the roads subject to certain well-defined restrictions, and provisions for the protection of the local authorities within the district. The capital of the Company was fixed at £1,000,000. The Act provides that every owner or occupier of premises requiring a supply of gas shall—

> Serve a notice upon the Company at their office specifying the premises in respect of which such supply is required and the day (not being an earlier day than a reasonable time after the date of the service of such notice) upon which such supply is required to commence:
>
> Enter into a written contract with the Company (if required by them so to do) to take not less than one million cubic feet per period of thirteen weeks and to continue to receive and pay for a supply of gas for a period of at least two years.

Among other provisions the Act states that the Company need not supply any person with gas unless such person is willing to contract for a supply of not less than 1,000,000 cubic feet in a year, nor are the Company to supply gas for use in private dwelling houses.

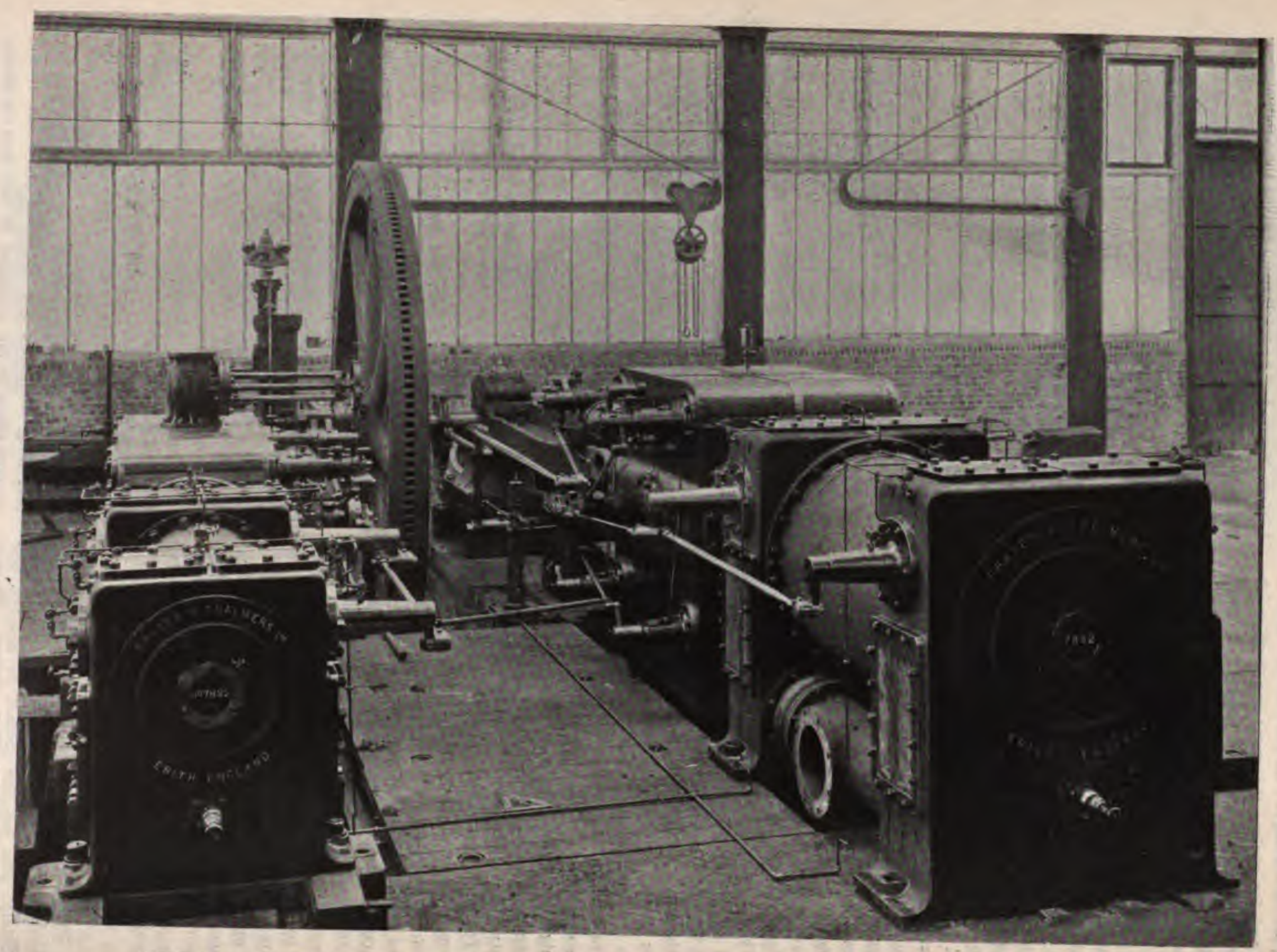
The Company is not allowed to supply gas for the purpose of illumination under heavy penalties. A penalty is also provided for failure to supply, and the Act further states:—

> It shall not be lawful for the Company at any time to supply gas (A) which contains more than fourteen per centum of carbon monoxide; or (B) which does not possess a distinctive and readily perceptible smell.

Each generating station must be provided with apparatus for the purpose of testing the thermal power of the gas supplied, and the presence of carbon monoxide in the gas.

As to the minimum heating value of gas it is provided that the gas supplied by the Company shall have a minimum heating value of 125 British thermal units per cubic foot at 32 deg. F., and 30 in. of mercury pressure, the product of combustion being cooled to 60 deg. F.

The Company may "charge and receive in respect of gas supplied by them, such sums as may be agreed between them and the consumer, being at a rate or price not exceeding threepence per one thousand cubic feet, if the quantity taken by the consumer be not less than four million cubic feet per quarter of thirteen weeks, and not exceeding fourpence per thousand cubic feet if the quantity taken by the consumer be less than the above.



TYPE OF COMPRESSOR PLANT SUPPLIED BY FRASER AND CHALMERS, LTD., FOR USE AT DUDLEY PORT.

The capacity of each of the three engines employed at Dudley Port is 3,130 cubic feet of gas per minute, which is compressed to 7 lb. per square inch, the steam pressure being 115 lb., speed 80 r.p.m. The size of the steam cylinders is 18 in. and 18 in., gas cylinders, 40 in. and 40 in., stroke 42 in.

Provided that if at any time it be proved to the satisfaction of the Board of Trade that the price of good quality slack exceeds the price of six shillings per ton delivered at the works of the Company, then the Board of Trade may, by order, authorise an increase in the price of gas, beyond the above maximum by one-eighth of a penny per one thousand cubic feet for every one shilling by which the price of slack per ton shall exceed the price of six shillings per ton delivered at the works of the Company, or by such other proportionate amount as the Board of Trade may determine, and for such period in either case as the Board of Trade may fix, with power to the Board to extend any such period, so long as such excess of price continues."

THE POSSIBILITIES OF GAS.

Concerning the possibilities of power gas to which this scheme may be said to offer a practical introduction we cannot do better than turn to the report of the Coal Commissioners. Professor Burstall in his evidence incidentally gave the following account of the Mond process and added some interesting anticipations on the subject of power gas and gas engines :—

THE MOND PROCESS.

Taking the best known form—that of Dr. Mond—it may clear matters to describe the formation of gas from common bituminous coal or slack. The coal is filled into a dome-shaped vessel ; it is here heated, and some of the gas is formed. This gas passes through the higher portion, and part of the tar is destroyed. The temperature of combustion is kept very low by means of the large quantity of steam blown in with the air (2½ tons of steam per ton of slack). The object of blowing in the steam is to keep the temperature of combustion lower, and also it contributes to the formation of gas of regular composition. The hot gas on leaving the producer passes into a regenerator, where some of its heat is given to the incoming air and steam ; from thence the gas passes to the washers, where any unburnt carbon is removed.

If ammonia recovery is desirable, the gas is led through an acid tower, where it meets a solution of ammonia sulphate, together with a small proportion of free acid, the ammonia combining to form sulphate of ammonia ; the gas then passes through the cooling tower and the air tower, and is now ready for use either in gas engines or for heating purposes. The composition of producer gas made by this method is :—

1. Carbon Monoxide	11 per cent.
2. Hydrogen	29 ,,
3. Marsh Gas	2 ,,
4. Carbon Dioxide	16 ,,
5. Nitrogen	42 ,,

The calorific value is about 140 British thermal units per cubic foot—that is, about a quarter of the calorific value of lighting gas. The amount of gas produced per ton of slack varies, but is about 140,000 cubic feet per ton. The heating power of the gas, as compared with the original heating power of the coal, is about 84 per cent., but it must be borne in mind, that, whether for heating or power purposes, a fuel can be used much more economically in the gaseous form than in the solid.

The value of the ammonia sulphate recovered per ton of slack is about 4s. 6d. which represents about three-quarters of the cost price of the slack if the situation of generation is favourable. The ammonia recovery is, however, only financially possible when the plant is of a large size. The ideal case for the manufacture of producer gas is to place the installation as near as possible to the pit mouth, thus saving the carriage. The small and inferior coal could be gasified, while the larger and better quality of coal could be shipped to other districts. In general, however, we may assume that, except for the raising of coal, there will not exist in the neighbourhood of the pit any considerable demand either for power or gas. It, therefore, becomes imperative either to turn the gas into electrical energy on the spot and to transmit to those points where a demand for energy exists, or to transmit the gas itself in pipes.

TRANSMISSION OF THE GAS.

By far the largest consumption of coal is that used for heating, whether for manufacturing purposes or the warming of buildings ; for this reason it is desirable, if possible, to transmit the producer gas itself into those neighbourhoods where a demand exists, not only for lighting and power, but for heating ; the obvious difficulty is, of course, the size of the mains. To transmit gas of such a low heating value, in such a manner as to be able to sell gas at prices which would compete with that of raw coal, it is necessary to use pressures in the gas mains very largely in excess of those used in lighting gas mains ; the question of leakage need not be a serious one if a properly-designed joint be employed.

Considerable experience on leakage from mains under pressure has been obtained from experiments on the air mains in Paris, where the pressure is about 100 lb. per square inch, and the length more than 20 miles. It was found that a leakage of less than ·4 per cent. per mile could be obtained, and this, with a network comprising a comparatively large number of branches and valves to customers. I see no reason to doubt the fact that in long mains, with comparatively few branches and valves, the leakage could be reduced to less than one-tenth per cent.

per mile. In the case of transmission, the only unavoidable loss is that due to friction, and this loss is extremely small if the velocities do not exceed about 50 ft. per second. The very high efficiencies which could be obtained in transmitting air or gas do not seem to have received that attention which they deserve until recently.

I have calculated the power transmitted by a 48-inch main under different conditions of pressure and velocity; it has been assumed that one brake horse power per hour can be obtained from 70 cubic feet of producer gas per hour.

It will be noticed that for pressures up to about four atmospheres that is, 44 lb. per square inch gauge pressures, and a moderate velocity of 30 feet per second, it is possible to obtain efficiencies above 87 per cent. with a transmission of eighty miles, the power transmitted by the main at full load being 75,000 h.p.; at lower loads, where the velocity is smaller, the efficiencies will be higher as the loss in the main varies as the square of the velocity. These efficiencies are considerably better than those obtained from electrical transmission. The question of the capital cost of the gas mains as against those of the electric mains cannot be stated in general terms, as much depends on the particular locality, but there is no reason to consider that the cost will be greater than for a given amount of power transmitted electrically.

These figures show that gas transmission has an extremely high efficiency if the velocities can be kept down. I estimate that of the total gas produced, 60 per cent. would be used for heating. It is well known that the fluctuations in the demand for gas for heating purposes are much smaller than those for lighting and power. It is fair to ussume, as the ratio of mean to maximum for this portion of the output would be 50 per cent., that the load factor of the whole plant would be 30 per cent. for the heating gas, and the remaining 40 per cent. would be used in gas-driven central stations producing 3-phase currents at pressures from 5,000 to 15,000 volts, according to the size of the districts which they had to cover. At these same stations the gas would be distributed at low pressures, so that no serious difficulty from leakage need be anticipated; the 3-phase current could be converted at suitable sub-stations into continuous current at 440 volts for use on trams and for lighting.

(*To be continued.*)

TABLE giving the length of transmission, H.P. transmitted, I.H.P. required for compressing, and the efficiency for a gas transmission through a main 4 feet diameter, 70 cubic feet of gas per brake horse-power hour. Mechanical efficiency of compressor = ·8, compression curve taken as P.V. 1·3 = Constant.

Initial Pressure Absolute.		Length of transmission in Miles.			Horse-power of Gas delivered by Mains.			I.H.P. required to compress the Gas.			Efficiency of Transmission V = 20, 30 or 40.
Lbs. □"	Atmospheres.	Initial Velocity in feet per sec. V. V = 20.	V = 30.	V = 40.	V = 20.	V = 30.	V = 40.	V = 20.	V = 30.	V = 40.	
15	1·02	7·66	3·4	1·92	13,130	19,200	26,260	30	44	60	99·7
15·4	1·05	18·6	8·2	4·65	13,550	19,800	27,100	65	95	130	99·5
16·2	1·1	34·5	15·3	8·6	14,150	20,700	28,300	116	171	233	99·2
17·6	1·2	61	27·1	15·2	15,500	22,600	31,000	273	399	545	98·2
22·0	1·5	133	59	33	19,300	28,350	38,750	780	1,120	1,535	96·2
29·4	2	150	66	37	28,850	37,820	51,600	1,780	2,610	3,565	93·4
44·1	3	178	79	44	38,750	56,700	77,500	4,500	6,596	9,000	89·6
58·8	4	182	83	46	51,650	75,500	103,200	7,780	11,400	15,550	87·0
73·5	5	191	85	48	64,600	94,600	129,100	11,550	16,910	23,100	84·9
88·2	6	194	86	48·5	77,500	113,500	155,000	15,890	23,290	31,875	83·0
102·9	7	196	87	48·9	90,300	132,000	180,700	20,630	34,560	41,370	81·5

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts.

CONTRACTS OPEN.

	Last Day.
Johannesburg.—Supply of 100 electric cars, two electric water-cars, five-ton crane, car traverser, and workshop tools for Municipal Council	March 6
Manchester.—Laying underground telephone pipes (Contract No. 11), with other appurtenant works for the Paving, Sewering, and Highways Committee. City Surveyor's Office, Town Hall, Manchester	March 6
Birmingham.—Supply and delivery of 1,500 tons of 7-inch tramway rails, British standard section No. 4, and 150 tons British standard section No. 4 4C, with all necessary fishplates for same, for the Public Works Committee. Mr. John Price, city engineer and surveyor, City Surveyor's Office, Council House, Birmingham	March 7
Altrincham.—Supply and delivery at Altrincham railway station of about 45 tons of steel girder rails, with the necessary fishplates, tiebars, bolts, nuts, washers, etc., for the Gas Company. Messrs. John Newton, Son and Bayley, 17, Cooper Street, Manchester	March 8
Stoke Newington.—Supply, délivery and erection of sub-station plant and mains. Four-section contract. Mr. W. F. Loveday, Borough Surveyor, Town Hall, Milton Road, Stoke Newington, S.E.	March 8
Broadstairs.—Construction, delivery, and erection at the above station of a horizontal tandem compound engine, condenser, well pumps, and all accessories. Mr. Percy Griffith, M. Inst. C.E., 54, Parliament Street, S.W.	March 11
Brighouse.—Widening of the Calder Bridge, Brighouse, by means of steel lattice girders and steel stanchions for the Corporation. Mr. S. S. Haywood, Borough Engineer, Municipal Offices, Brighouse	March 11
Belgium.—The "Bulletin Commercial" announces that the Belgian State Railways invite tenders for the installation of two sets of ventilating and heating apparatus in the central workshops at Mechlin. Particulars of M. Slaghmuylder, Engineer-in-chief, Station du Nord, Brussels	March 6 March 13
Park Royal.—Supply, delivery, and erection of plant in connection with the electricity generating station at Park Royal and proposed sub-stations and distributing centres at various places, for the Great Western Railway Company. Messrs Kennedy and Jenkin, 17, Victoria Street, S.W.	March 13
Axbridge (Somerset).—Supply of about 600 tons of cast-iron socket water-pipes 7-in. to 4-in in diameter, for Axbridge Union Rural District Council	March 13
South Shields.—Supply, delivery and erection of the following plant in connection with the electricity supply department:—One multitubular marine type boiler, two medium-speed open-type vertical engines for two 550 k w. direct current traction generators, two 500 k.w. direct current generators and traction switchboard. Mr. J. H. Cawthra, Borough Electrical Engineer	March 13
Liverpool.—Construction of covered conduit about 1,100 yards in length, and other works connected therewith, situated in the townships of Withnell and Wheelton, in the county of Lancaster, for the Water Committee of the Liverpool Corporation. Mr. H. Dawkin Williams, Surveyor, Bryn Menin	March 14
Llandyfodwg and Llantrisant (Wales). The Ogmore and Garw Urban District Council invite tenders for two distinct and separate schemes of bridging the valley at Gilfach, by extending Coronation-road, Evanstown, in the parish of Llandyfodwg, to join the highway known as Gilfach-road, in the parish of Llantrisant Mr. H. Dawkins Williams, Surveyor, Bryn, Menin	March 14
London.—Supply of electrical stores for year ending March 31, 1906, for the Fulham Borough Council. Town Clerk, Town Hall, Fulham	March 15
Welwyn.—Supply and delivery of about 58 tons of 9-inch cast-iron pipes, for the Welwyn (Herts) Rural District Council. Messrs. Herbert Walker and Son, Albion Chambers, King Street, Nottingham	March 27
Grindleford and Rowsley.—Construction of the Grindleford to Rowsley section of the Derwent aqueduct, in the county of Derby, for the Derwent Valley Water Board. Mr. Edward Sandeman, Engineer, Bamford, Sheffield	March 27
Shanghai.—The Shanghai Municipal Council invite tenders for the construction and operation of about 24 miles of electric tramways on the trolley system in the streets of the Settlement of Shanghai; alternative proposals are desired for the single-trolley and double-trolley lines. Council's agents, Messrs. John Pook and Co., 63, Leadenhall Street, London, E.C., and Messrs. Fearon Daniel and Co., 90, Wall Street, New York.	March 31
Newport (Mon.).—Construction of main outfall and branch sewers for the Western Valleys Sewerage Board. Particulars at offices of Mr. Baldwin-Latham, Parliament Mansions, Victoria Street, S.W.; Mr. Geo. Chatterton, 6, The Sanctuary, Westminster, S.W.; or Mr. T. S. Edwards, Clerk to the Board, Newport (Mon.)	April 8

COMING CONTRACTS.

Panama Canal.—The last plans which have been laid before the Commission deal with the construction of a sea-level canal at a cost of over £45,000,000, which would take 10 to 12 years to construct.

Blyth.—The Harbour Commissioners have under consideration a scheme for widening and deepening the middle and upper harbours at an estimated cost of £21,000.

Cumberland.—The proposed electrical installation at the Cumberland lunatic asylum is estimated at £6,600.

Grimsby.—The construction of a light railway has been sanctioned in connection with the proposed new dock at Grimsby. The line will run from the proposed dock area at Immingham into the borough.

Bath.—The City Council are about to apply for a loan of £10,000 for electric supply extensions.

Warwick.—Tenders for sinking a well in connection with new scheme of water supply prepared by Messrs. Willcox and Raikes have been received, and the engineers instructed to obtain tenders for the laying of mains, provision of pumping machinery, and erection of engine-house.

Hartlepool.—At the annual meeting of the Hartlepool Port and Harbour Commissioners, the Chairman stated that it would be necessary shortly to obtain sanction to borrow £30,000 or £40,000 for further dredging plant.

CONTRACTS CLOSED.

Karachi.—Messrs. Wm. Simons and Co., Ltd., Renfrew, have received an order from the Karachi Port Trust for a very powerful hopper dredger of 1,250 tons hopper capacity being a duplicate of a dredger which they supplied to the above Trust about six years ago. The vessel is specially constructed to dredge hard material.

Worksop.—Messrs. Markham and Co., Ltd., Chesterfield, have secured the contract for supplying the large winding engines required by the Wigan Coal and Iron Co., Ltd., for their Manton Colliery, near Worksop; also the main winding engines for the Dinnington Main Coal Company's new sinking, near Sheffield.

Islington.—The contract for a complete Ash Elevator plant for the boiler-house of the Islington Urban District Council has been placed with Messrs. Graham, Morton and Co., contractors, Leeds. The elevator is motor-driven by means of a 3-b.h.p., running at 500 revolutions per minute.

London.—The Brush Electrical Engineering Company have received an order for carbodies, with radial trucks and equipments, from the Yarmouth Corporations.

London.—J. Williams and Sons (Cardiff), Ltd., have secured an order for 1,500 tons of castings for one of the London tube railways.

Japan.—Robert Stephenson and Co. Ltd., have just received an order for ten large passenger engines and tenders for the Indian State Railways. The engines are passenger engines, six-wheel coupled with leading bogie, and six-wheel tenders; cylinders 19 in. by 26 in.

Portsmouth.—Alley and Maclellan, Glasgow, have recently received orders from the Admiralty for two air compressors for Portsmouth Dockyard.

Bishop Auckland.—We are informed that Graham, Morton and Co. have obtained the contract to extend the coal-screening plant for the Dean and Chapter New Colliery at Bishop Auckland, County Durham. After the addition the plant will be able to handle 5,000 tons per day.

Liverpool.—C. and A. Musker (1901), Liverpool, have received the order from the Mersey Docks and Harbour Board for supplying and fixing eight hydraulic gate machines for the passage between Brocklebank and Canada Dock, Liverpool.

Glasgow.—Mountain and Gibson secured the contract from the Glasgow Corporation Tramways Department for 100 of their "M.G." 21 E.M. electric motor trucks for tramcars, fitted complete with steel-tired wheels and steel axles.

Buncrana.—James Gordon and Co. have obtained the contract for the supply, delivery and erection of the complete hydraulic and gas power plant for the electric light station at Buncrana, Ireland.

Middleton.—Meldrum Bros. have obtained a contract to erect a bridge, and to supply a Meldrum simplex destructor, for Middleton, Lancs.

South America.—The Leeds Forge Company, Ltd., has received an order for 500 steel wagons, each of 40 tons capacity, from a South American Railway Company.

APPOINTMENTS VACANT.

	Last Day.
Tredegar.—Gas and water works' engineer under Tredegar Urban District Council...	March 20
Llanelly.—General superintendent of harbour, docks, and railways under Llanelly harbour trustees. Salary, £300 per annum	March 16

APPOINTMENTS FILLED.

Macclesfield.—The Macclesfield Town Council have appointed Mr. Herbert Goodwin as assistant surveyor at a salary of £120 per annum.

Leigh.—The Leigh Town Council have appointed Mr. Stanley Wilson, deputy town clerk of Warrington, as town clerk at a commencing salary of £400, rising by £50 annual increments to £600.

London.—The Honourable Alfred Erskine Gathorne-Hardy has been appointed to be a Commissioner under the Railway and Canal Traffic Act, 1888, in the room of Viscount Cobham, resigned. Mr. Alfred Gathorne-Hardy takes the position of Chairman of the Light Railway Commission (unpaid) in the place of the Earl of Jersey, resigned.

Rangoon.—Mr. Walter G. Longdin, of Warrington, has been appointed assistant civil engineer to the municipality of Rangoon, Burmah.

Luton.—Mr. S. F. L. Fox, deputy borough engineer of Newport, Mon., has just been appointed borough engineer of Luton, and surveyor to the Education Committee of the corporation, at a salary of £350 a year. Mr. Fox will commence his duties on the 20th inst.

A correspondent requires information as to an addressing machine, printing addresses with stencils. Information addressed to the offices of PAGE'S WEEKLY will be duly forwarded.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

The following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares business is being currently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our Share List will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from possible inaccuracies.

STOCK EXCHANGE SETTLING DAYS.—Settling days on the Stock Exchange are as follows :—

Consols: April 5th. General Settlements: March 15th, 30th, April 13th. Bank Rate, April 21st, 1904, 3 per cent.

I.—ENGINEERING, IRON, AND STEEL COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
11,370	5	5%	Alldays & Onions Pneumatic Engineering, Ltd.	3	2¾— 3
10,000	5	3/-	Do. Cum. Pref. 6 per cent. ..	5	4½— 5
3,210,000	1	2/6	Armstrong (Sir W. G.), Whitworth and Co., Ltd.	1	3 3/16— 3 5/16
76,970	5	2/-	Do. 4% Cum. Pref.. ..	5	5⅜— 5⅝
1,500,000	100	4%	Do. 4% 1st Mort. Dbs. Rd.	100	103 —105
£100,000	100	4½%	Aveling and Porter, Ltd., 4½% Reg. Mt. Debs. Red.	100	96 — 99
530,000	1	1/7½	Babcock and Wilcox, Ltd., Ord. ..	1	4¼— 4½
100,000	1	7½d.	Do. ,, 6% Cum. Pref.	1	1½— 1⅝
20,000	5	3/-	Baker (Joseph) and Sons, Ltd., 6% Cum. Pref...	5	5 — 5½
250,000	1	6⅔d.	Baldwins, Ltd., 5½% Cum. Pref. ..	1	1 — 1⅛
£250,000	Stk	4½%	Do. 1st Mt. 4½% Deb. Stk. Red.	100	101 —103
150,000	4½	2/8⅖	Barrow Hæmatite Steel Co., Ld., O.	4½	1 9/16— 1 11/16
50,000	4½	6/-	Do. do. Cum 2nd. Pref.	4½	4⅜— 4⅝
33,334	5	2/6	Bayliss, Jones and Bayliss, Ltd., 5% Cum. Pref. Shares	5	4¾— 5¼
£500,000	100	—	Beardmore (Wm.) & Co., Ltd., 4½% 1st Mt. Debs., Red., Scrip 50% pd	—	101 —103
50,000	10	6/-	Bell Brothers, Ltd., 6% Cum. Pref.	10	11¾— 12¼
£366,600	Stk	4%	Do 4% Deb. Stock, Red.	100	99 —101
200,000	1	1/-	Beyer, Peacock and Co., Ltd., Ord.	1	11/16 — ¾
300,000	1	6⅔d.	Do. 5½% Cum Pref.	1	27/32 — 29/32
£300,000	Stk	4½%	Do. 4½% Red. Deb. Stock	100	94 — 97
1,629,760	1	6d.	Bolckow, Vaughan and Co., Ltd., O. Nos. 1-1,629,760	1	1 —1 1/16*
1,860,900	1	3⅔d.	Do. Nos. 1,639,101-3,500,000	12/-	17/32— 19/32*
1,160,000	1	4½d.	Brown (John) and Co., Lim., Ord., Nos. 1-1,160,000	15/-	1 3/16— 1 5/16
590,000	1	6d.	Do. Ord., Nos. 1,160,001-1,750,000	1	1 25/32— 1 27/32
74,000	10	5/-	Do. 5 % Cum. Pref.	10	11¼— 11¾
154,500	5	2/6	Cammell, Laird & Co., Ltd., Ord. ..	5	8¼— 8¾
232,500	5	2/6	Do. 5% Cum. Pref. ..	5	5 7/16— 5 9/16
450,000	1	1/6	Clayton & Shuttleworth, Ltd., Ord.	1	15/16— 1
70,000	5	2/6	Do. 5% Cum. Pref.	5	5⅜— 5⅝
£250,000	Stk	4%	Do. 4% 1st Mort. Db. Stk. Red	100	100 —102
100,000	10	7/6	Consett Iron Co., Ltd., Ord.. ..	7½	31½— 32½
57 031	10	10/-	Crossley, Bros., Ld., Ord. 40340/97370	10	16¼—16¾
40,339	10	5%	Do. 5% Cum. Pref.	10	11¼—11¾
75,000	1	2/6	Delta Metal, Ltd. Shares	1	2⅛— 2¼
1,259,594	1	3⅔d.	Dorman, Long & Co., Ltd.	1	21/32— 23/32
£400,000	Stk	4%	Do. 4% 1st Mort. Perp. Deb. Stk.	100	91 — 94
200,000	5	3/-	Dunderland Iron Ore Co., Ltd., 6% Cum. Pref. and Participating..	5	3⅜— 3⅝
250,000	1	9⅔d.	Dunlop (James) & Co., Ltd., Ord...	1	⅝— ¾
300,000	1	7½d.	Do. 6% Cum. Pref. ..	1	15/16 - 1 1/16
4,721	13	12/-	Ebbw Vale Steel, Iron & Coal Co., Ltd.	13	9 — 10
69,754	13	12/-	Do. do. do.	10	7⅜— 7⅞
20,250	10	8/-	Elliott's Metal, Ltd.	8	4½— 5½
5,000	10	5%	Do. Cum. Pref. 5%	10	8¾— 9¼
186,748	Stk	4%	Do. Deb. 4%	100	94½— 96½
25,000	10	6/-	Fairfield Shipbuilding & Engng. Co., Ltd., 6% Cum. Pref. ..	10	10½— 11
£250,000	Stk	4½%	Do. 4½% Mort. Deb. Stk. Red.	100	97 —100
9,000	10	10%	Fleming & Ferguson, Ltd. Ord. Nos. 1/9000..	10	12½—12¾
6,000	10	5%	Do. 5% Cum. Pref. Nos. 9001/15000	10	9½—10
126,000	3	3/-	Fraser & Chalmers, Ltd., Ord. ..	3	4⅜— 4⅞
21,000	3	1/6	Do. 7½% Cum. Pref.	3	5¾— 6¼
10,000	10	5%	Galloways, Ltd., 5% Cum. Pref. 18001/28000	10	6 — 7
£150,000	Stk	4%	Do. 4% 1st Mort. Deb Red..	100	90½—91½
16,800	10	—	Greenwood & Batley, Ltd., Ord. ..	10	4 — 4¼
9,600	10	7%	Do. 7% Cum. Pref.	10	10¼— 10¾
965,000	1	1/-	Guest, Keen & Nettlefolds, Ltd. Ord.	1	2¼— 2⅜*
344,000	5	2/6	Do. 5% Cum. Pref.	5	5⅝— 6⅛
£1,850,500	Stk	4%	Do. 4% Irred. Mort. Deb. Stk	100	105 —107
13,000	5	2/6	Gwynnes, Ltd., 5% Cum. Pref. ..	5	2 — 3
250,000	1	1/-	Hadfield's Steel F'dry Co., Ld., Ord.	1	3 5/16— 3 7/16
20,000	10	4/6	Do. 4½% Cum. Pref.	10	10¾— 11¼
30,000	5	3/-	Hall (J. & E.), Ltd. 6% Cum. Pref...	5	5 — 5½
408,505	1	1/6	Harvey United Steel Co., Ltd. ..	1	1 5/16— 1 7/16
47,500	10	7½%	Hawthorn, Leslie & Co., Ltd. Ord.	10	10¾— 11
28,001	5	7/-	Head, Wrightson & Co., Ltd. ..	5	4¾— 5¼
85,000	1	7½d.	Hill (Richard) & Co. (1899) Ld., Ord.	1	⅝— ¾
18,000	5	3/-	Do. 6% Cum. Pref.	5	4⅜— 4⅞
30,000	10	6/-	Hornsby (Richard) & Sons, Ld., Ord.	8	5½— 6

ENGINEERING, IRON, AND STEEL COMPANIES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
750,000	1	6d.	Howard & Bullough, Ltd., Ord. ..	1	1⅝— 1¾
25,000	10	6/-	Do. 6% Pref. (Non-Cum.) ..	10	12¼— 12¾
£250,000	Stk	4%	Do. 4% Deb. Stk., Red. after 1905	100	98 —101
37,500	10	20	Kynoch, Ltd.	10	18¾— 19¼
49,537	10	5%	Do. Cum. Pref. 5%	10	10⅝— 11⅛
300,000	1	4½d.	Lambert Bros., Ltd., Ord.	1	⅝— ⅞
50,000	5	2/9	Do. 5½% Cum. Pref.	5	4 — 4½
40,000	3	2/1½	Leeds Forge Co., 7% Cum. Pref. ..	3	3¾— 4¼
200,000	1	7½d.	Lysaght (John), Ltd., 6% Cum. Pf.	1	1 5/16— 1 7/16
£300,000	Stk	4½%	Do 4½% 1st Mt. Deb. Stk., Red.	100	108 —110
40,000	10	5/-	Mather & Platt, Ld., 5% Cum. Pref.	10	11 —11½*
210,000	1	6d.	Measures Bros., Ltd., Ord.	1	11/16— 13/16
75,000	1	6⅔d.	Do. 5½% Cum. Pref.	1	13/16— 15/16*
£75,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	94 — 97
21,943	5	2/6	Muntz Metal, Ltd.	5	5⅜— 5⅝
14,248	5	5%	Do. Pref. 5%	5	5⅛— 5⅝
5,000	62½	47/6	Nantyglo and Blaina Iron Works, Ltd., 8% Cum. Pref.	62½	76 — 80
73,000	10	5/-	N. Brit. Loco. Co., Ltd., 5% Cm. Pf.	10	12 — 12¼
80,000	5	—	North-Eastern Steel Co., Ltd., Ord.	5	—
£250,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	90 — 93
122,000	5	2/-	Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B"	5	3⅞— 4⅛
50,000	5	3/-	Do. 6% Cum. Pref. "A" ..	5	5¾— 6¼
70,000	10	6/-	Pease & Partners, Ltd., Ord. ..	10	10¾— 11¼
£400,000	Stk	4%	Do. 4% Perp. Deb. Stock ..	100	97 —100
20,000	5	3/-	Peebles (Bruce) & Co., Ld., 6% Cm.P.	5	4¾— 5
65,000	1	—	Pooley (Henry) & Son., Ltd., Ord ..	1	6/6— 7/-
13,000	5	—	Do. 5½% Cum. Pref.	5	4¼— 4¾
230,000	1	—	Projectile Co. (1902), Ltd., Ord. ..	1	½— ⅝
126,938	5	2/-	Rhymney Iron Co., Ltd.	5	1⅞— 2
73,062	5	2/-	Do. New	5	1½— 1¾
£330,000	—	5%	Do. 5% Mort. Deb., Red. ..	100	99 —102
350,000	1	7½d.	Richardsons, Westgarth & Co., Ltd., 6% Cum. Pf. ..	1	⅞— 15/16
£350,000	Stk	4½%	Do. 4½% Perp. Deb. Stock ..	100	94 — 96
35,000	10	12/-	Ruston, Proctor & Co., Ltd... ..	10	9¼— 9¾
275.000	1	6d.	Scott (Walter), Ltd., Ord.	1	13/16— 15/16
300,000	1	7½d.	Do. 6% Cum. Pref. ..	1	1— 1⅛*
£300,000	Stk	4%	Do. 4% Perp. Deb. Stk.	100	94 — 96
£115,300	100	5%	Shelton Iron, Steel and Coal Co., Ld. 1st Charge 5% Debs.. Red ..	100	91 — 94
£97,900	100	6%	Do. 6% 2nd Mort. Debs., Red.	100	91 — 95
250,000	1	1/-	South Durham Steel & Iron, Ltd. Or.	1	⅝— 11/16
300,000	1	7½d.	Do. 6% Cum. Pref...	1	15/16 — 1
£300,000	Stk	4½%	Do. 4½% Per. Deb. Stock	100	89 — 92
49,560	10	2½%	Steel Co. of Scotland Ord. 1/49560..	9	5 — 5½
£125,240	Stk.	5%	Do. 5% Trust Mort. Deb. ..	100	106½—107½
25,000	10	—	Stephenson (Robert) & Co., Ltd., Or.	10	2¼— 2¾
25,000	10	5/6	Do. 5½% Cum. Pref. ..	10	4¼— 4¾
£250,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	83— 86
85,000	10	9/-	Stewarts & Lloyds, Ltd., Ord. ..	10	16¾— 17¼
55,000	10	6/-	Do. 6% Cum. Pref.	10	14¼— 14¾
634,732	1	4.69d.	Swan, Hunter & Wigham-Richardson, Lim. Ord.	1	¾— ⅞
538,845	1	6d.	Do. 5% Cum. Pref.	1	15/16— 1 1/16
£240,000	Stk	4¼%	Do. 4¼% 1st Mort. Deb. Stk. Red	100	98 — 101
300,000	1	6d.	Thames Iron Works, Shipbuilding & Engineering Co., Ltd., 5% Cum. Pf.	1	½— 9/16
£200,000	100	4%	Do. 4% Irredeem. 1st Mort. Deb.	100	67 — 71
£160,000	1	7½d.	Thornycroft (John I.) & Co., Ltd. 6% Cum. Pref.	1	15/16— 1 1/16
10,000	10	5/-	Tylor (J.) & Sons, Ltd. 5% Cum. Pf.	10	9½— 10
$508495200	$100	$½	United States Steel Corp. Com. Stk.	$100	36⅜— 36⅝
$360314100	$100	$1¾	Do. 7% Cum. Pref. Stock	$100	98¼—98¾*
$162268000	$1000	5%	Do. 10-60yr. 5% Skg. Fd. G. Bds.	$1000	97 — 99
3,350,000	1	1/-	Vickers, Sons & Maxim, Ltd. Ord..	1	2 7/16— 2 9/16
750,000	1	6d.	Do. 5% Non-Cum. Pref. ..	1	1⅛— 1¼
£750,000	Stk	5%	Do. 5% Non-Cum. Pref. Stock.	100	114 —117
£1,250,000	Stk	4%	Do. 4% 1st. Mort. Deb. Stk. Red.	100	105 —107
£1,000,000	100	4½%	Do. 4½% 2nd Mort. Debs., Red.	100	105 —107
225,000	1	1/2⅔	Weardale Steel, Coal & Coke, Ltd., Def. Ord.	1	¾— ⅞
500,000	1	7½d.	Do. 6% Cum. Pref. Ord. ..	1	⅞— 1
£300,000	Stk	4%	Do. 4% Perpetual Deb. Stock	100	85 — 89
7,637	5	2/9	Weldless Steel Tube, Ltd., Cum. Pref. 5½	5	4¾— 4⅞
300	Stk	4½%	Do. Mort. Deb. 4½%	100	91 — 97
66,666	5	3/.	Willans & Robinson, Ord.	5	1½— 2½
66,666	5	3/-	Do. 6% Cum. Pref.	5	3 — 4
£246,641	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red	100	77 — 82
£150,000	Stk	4½%	Yorkshire Iron & Coal Co., Ltd., 4½% 1st Mort. Deb. Stk. Red.	100	81 — 86

Stocks and Shares marked * are quoted ex-dividend.

II.—ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name	Paid up.	Closing Prices.
70,000	1	6d.	Alliance Elec. Co., Ltd. 5% Cum. Pf.	1	⅝— ⅞*
125,000	1	7½d.	Aron Elec. Meter Ltd., 6% Cum. Pf.	1	7/16— 9/16
120,000	1	9⅜d.	Bell's Asbestos Co., Ltd.	1	⅝— ¾
100,000	5	4/-	British Insulated & Helsby Cables Ltd., Ord. ..	5	5¾— 6¼
100,000	5	3/-	Do. 6% Cum. Pref.	5	5¼—5¾
£500,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Rd.	100	101 —104
£200,000	Stk	4½%	British Thomson-Houston Co., Ltd., 4½% 1st Mort. Deb. Stk. Red...	100	99 —101*
400,000	5	3/-	British Westinghouse Electric and Manufac. Co., Ltd., 6% Pref...	5	2¾— 2 13/16
£616,358	Stk	4%	Do. 4% Mort. Deb. Stk. Red...	100	87 — 89
105,731	2	2/-	Brush Elec. Enging. Co., Ltd., Ord..	2	½— ¾
150,000	2	2/4⅞	Do. 6% Pref.	2	1½— 1¾
£125,000	Stk	4½%	Do. 4½% Perp. 1st Deb. Stk...	100	92— 95*
£125,000	Stk	4½%	Do. 4½% Perp. 2nd Deb. Stk.	100	79 — 82
35,000	5	5/-	Callender's Cable & Constn. Ltd. Ord.	5	10¾ - 11¼
40,000	5	2/6	Do. 5 % Cum. Pref.	5	5½ - 5¾
£200,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Red.	100	105 —107
85,000	3	1/6	Crompton & Co., Ltd...	3	2⅛— 2⅜
£100,000	—	5%	Do. 5% 1st Mort. Reg. Debs.	100	93— 98
52,000	5	10/-	Dick, Kerr & Co., Ltd., Ord. ..	5	7¾— 8¼
61,000	5	3/-	Do. 6% Cum. Pref.	5	5⅞— 6⅛
£300,000	Stk	4½%	Do. 4½% Deb. Stock, Red. ..	100	105 —107
233,334	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	1⅛— 1⅜
£233,334	Stk	4%	Do. 1st Mort. 4% Iree. Deb. Stk.	100	105 —108
99,261	5	1/6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	3	⅝— ⅞
17,139	5	2/6	Do. "A" Shares Nos. 01-017,139	5	1 — 1½
£344,023	Stk	4%	Do. 4% Deb. Stock Red. ..	100	77 — 82
£100,000	Stk	5%	Do. 5% Second Deb. Stk. Red.	100	79 — 84
112,100	2	1/7½	Electric Construction Co., Ltd. ..	2	1⅛— 1¼
31,390	2	2/9⅜	Do. 7% Cumulative Pref. ..	2	2¼— 2½
£200,000	Stk	4%	Do. 4% Perp. 1st Mt. Deb. Stk.	100	97 — 99
10,248	10	7/6	Evered and Co., Ltd...	10	13 — 15
£100,000	Stk	5%	Ferranti, Ltd., 5% 1st Mort. Deb. Stock, Red...	100	90 — 95
25,000	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9½— 10
£200,000	Stk	4%	Do. 4% 1st. Mt. Deb. Stk., Red.	100	91 — 96
35,000	5	5/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	12¾ —13
35,000	5	2/3	Do. 4½% Cum. Pref... ..	5	5⅜— 5⅝*
£50 000	Stk	4½%	Do. 4½% Mt. Deb. Stk. Red.	100	109—111*
50,000	10	5/-	India Rubber, Gutta Percha & Telegraph Works Co., Ltd.,	10	16 — 17
£300,000	100	4%	Do. 1st Mort. Deb. Red. ..	100	100 —103
7,500	10	—	Parker, Thos., Ltd.	10	6½— 7
100,000	1	3%	Scott (Ernest) & Mountain, Ld., Ord.	1	16/—16/6
37,350	12	12/-	Telegraph Construction and Maintenance Co., Ltd.	12	35 — 37
£150,000	100	4%	Do. 4% Deb. Bonds	100	102 —104

III.—ELECTRIC TRACTION.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
120,000	5	3/-	Anglo-Argentine Trams Co., Ld., Or.	5	8⅜— 8⅝
260,007	5	2/6	Do. 5% Cum Pf.	5	5⅜— 5⅞
£230,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888 ..	100	140 —143
20,000	10	6/-	Barcelona Trams Co., Ltd., Ord. ..	10	11¾— 12¼
10,000	10	5/-	Do. 5% Cum Pf. Shares	10	9 -- 10
£46,300	100	5%	Do. 5% Debs., Red. ..	100	99 --102
£191,326	Stk	4½%	Do. 4½% Red. Deb. Stk.	100	96 —100
75,606	1	—	Bath Elec. Trams. Ld., Pf. Or. ..	1	¾ — ⅞
59,394	1	11·49d	Do. 5% Cum. Pf. ..	1	15/16— 1 1/16
75,000	5	—	Brisbane Electric Tram Investment Co., Ltd., Ord... ..	5	1¼— 1¾
75,000	5	2/6	Do. 5% Cum. Pf. ..	5	3¾— 4¼
£425,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	94 — 98
£200,000	Stk	6%	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	102 —105
		%	Pref. Ord. Stock	100	100 —103
133,301	10	6/-	Brit. Electric Traction, Ltd., Ord.	10	9½— 9¾
156,437	10	6/-	Do. 6% Cum. Pref.	10	10⅝—11⅛
£1,000,000	Stk	5%	Do. 5% Perp. Deb. Stk. ..	100	121 --123
£250,000	Stk	4½%	Do. 4% 2nd Deb. Stk. Red..	100	97 — 99
100,000	5	1/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	3¾— 4
40,500	5	3/-	Do. "A" 6% Cum Pref. ..	5	5½— 5[illegible]
27,000	5	3/-	Do. "B" do.	5	5¼— 5[illegible]

ELECTRIC TRACTION.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Clo Pri
£200,000	Stk	5%	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	94 -
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	108
102,268	5	3/-	Calcutta Tramways Co., Ltd. ..	5	8⅝-
£350,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	106 -
480,000	1	6d.	Cape Electric Tramways, Ltd. ..	1	1⅝-
40,000	5	2/6	City of Birmingham Trams Co., Ltd. 5 % Cum. Pref.	5	4⅞-
£300,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	101 -
£120,000	Stk	5%	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	101 -
60,000	10	6/-	Dublin United Trams. Co. (1896), Ltd., Ord. ..	10	13 -
59,987	10	6/-	Do. 6% Pref...	10	15½
30,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	3 -
£150,000	Stk	4%	Do. 4% Deb. Stock.. ..	100	89 -
125,000	10	5/-	London United Trams. (1901), Ltd., 5% Cum. Pref.	10	10½-
£1,031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	103
£50,000	Stk	5%	Madras Electric Trams (1904), Ltd., 5% Deb. Stock, Red.	100	101
314,016	1	—	Metropolitan Elec. Trams, Ltd., Def.	1	[illegible]
500,000	1	6d.	Do. 5% Cum. Pref... ..	1	[illegible]
£350,000	Stk	4½%	Do. 4½% Deb. Stock, Red.	100	104
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	½
110,923	8	3/2⅝	North Metropolitan Tramways Co..	8	4
£150,000	100	3½%	Do. 3½% Mort. Debs.	100	90
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red..	100	104
24,500	10	10/-	Potteries Elec. Traction Co., Ld., Or.	10	8
24,500	10	5/-	Do. 5% Cum. Pref. ..	10	8¾
£220,000	Stk	4½%	Do. 4½% Deb. Stk., Red.	100	102

IV.—ELECTRIC LIGHTING AND POWER

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Cl Pr
7,500	10	16/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. ..	10	12
7,500	10	4/6	Do. 4½% Cum. Pref. ..	10	9
7,500	10	6/-	Do. 6% Cum. Second Pf. ..	10	11
£70,000	Stk	4½%	Do. 4½% Deb. Stock Red ..	100	104
14,000	5	2/-	Bromley (Kent) Elec. Lt. & Pr. Co. Ld	5	5
£50,000	Stk	4½%	Do. do. 4½% 1st Deb. Stk. Red.	100	101
27,507	5	4/6	Brompton & Kensington Elec. Supply Co., Ltd. Ord. ..	5	10
12,493	5	3/6	Do. 7% Cum. Pref. Shares..	5	10
60,000	5	3/-	Calcutta Elec. Sup. Cor. Ltd., Ord..	5	9
£288,782	Stk	4%	Central Elec. Sup. Co., Ltd., 4% Gua. Deb. Stk. ..	100	105
70,000	5	4/-	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord... ..	5	7
80,000	5	2/3	Do. do. 4½% Cum. Pref...	5	5
£350,000	Stk	4%	Do. do. 4% Deb. Stk. Red.	100	102
44,436	5	3/9	Chelsea Elec. Sply. Co., Ltd., Ord.	5	6
£150,000	Stk	4½%	Do. do. 4½% Deb. Stk., Red	100	109
70,595	10	5/-	City of London El. Lghtg. Co., Ld., O.	10	12
40,000	10	6/-	Do. 6% Cum. Pref.	10	13
£400,000	Stk	5%	Do. 5% Deb. Stk., Red ..	100	122
£300,000	Stk	4½%	Do. 4½% 2nd Deb. Stk., Red	100	103
40,000	10	4/-	County of London Elec. Supply Co., Ltd., Ord.	10	9
30,000	10	6/-	Do. 6% Cum. Pref.	10	12
£400,000	Stk	4½%	Do. 4½% Deb. Stk., Red. ..	100	109
70,000	5	2/6	Edmundson's Elec. Cor. Ltd., Ord.	5	6
70,000	5	3/-	Do. 6% Cum. Pref.	5	6
£300,000	Stk	4½%	Do. 4½% 1st Mort. Db. Stk. Reg	100	106
£80,000	Stk	5%	Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. Stk. Red.	100	86
10,000	5	2/-	Folkestone Elec. Supply Co., Ld., O.	5	5
£50,000	Stk.	4½%	Do. 4½% 1st Deb. Stk., Red.	100	101
15,000	10	—	Havana Electricity Co., Ltd... ..	10	9
13,000	5	3/6	Hove Elec. Lighting Co., Ltd., Ord.	5	7
£50,000	Stk	4½%	Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock, Red.	100	10
150,000	1	—	Kalgoorlie Electric Power & Lighting Corp, Ltd., 6% Cum. Pref.	1	[illegible]
21,000	5	7/-	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord. ..	5	12

Stocks and Shares marked * are quoted ex-dividend.

ELECTRIC LIGHTING AND POWER.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£135,000	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	102 —104
111,000	3	1/9⅜	London Elec. Supply Corp., Ld., Ord.	3	2¼ — 2¾*
60,000	5	3/-	Do. 6% Pref.	5	5¾ — 6*
£371,895	Stk	4%	Do. 4% 1st Mort.Db.Stk., Red.	100	98 —100
100,000	10	9/-	Metropolitan Elec. Sup. Co., Ld., Or.	10	18¾— 19¼
76,121	5	2/3	Do. 4½% Cum. Pref.	5	5⅝ — 5¾
220,000	Stk	4½%	Do. 4½% 1st Mort.Db.Sk., Red.	100	110 —115
250,000	Stk	3½%	Do. 3½% Mort. Deb. Stk., Red.	100	97 — 99
£250,000	—	4½%	Midland Elec. Corp. for Power Distribution, Ld., 4½% 1st Mort. Deb.	100	97 —100
10,852	10	6/-	Notting Hill Elec. Ltg. Co. Ltd. Ord.	10	14½— 15
£59,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	102 —104
16,500	5	2/6	Oxford Electric Co. Ltd., Ord. ..	5	6¼— 6½
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	98 —100
£84,700	100	4½%	Royal Elec. Co. (of Montreal) 4½% 20-yr. 1st Mort. Deb	100	100 —102
40,000	5	9/6	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	13¼—13¾*
20,000	5	3/6	Do. 7% Pref...	5	8¼—8¾*
£150,000	Stk	3½%	Do. 3½% Deben. Stock, Red	100	98 —100
12,000	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2⅝— 3⅛*
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	79 — 83
65,000	5	3/-	South London Elec. Sup. Co., Ltd. O.	5	4⅛— 4⅜
100,000	1	—	South Metropolitan Elec Light & Power Co., Ltd. Ord.	1	⅞ — 1
50,000	1	8⅖d.	Do. 7% Cum. Pref.	1	1⅜— 1 7/16
£100,000	Stk	4½%	Do. 4½% 1st Deb. Stock Red.	100	107 —110
50,000	5	2/6	Urban Electric Supply Co., Ltd., O.	5	5 — 5⅜
30,000	5	2/6	Do. 5% Cum Pref.	5	5⅛— 5¼
£200,000	Stk	—	Do. 4½% 1st Mort.Deb.Stk.Red	100	105 —107
110,000	5	7/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	13 —13½*
28,151	5	2/6	Do. 5% Cum. Pref.	5	6⅛— 6⅜

V.—TELEGRAPH & TELEPHONE COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£34,800	100	4%	African Direct Tel. Co., Ld., 4% Mt. Debs. (Series A), Red.	100	99 —102
25,000	10	—	Amazon Telegraph Co., Ld... ..	10	2¼ — 2¾
£763,580	Stk	17/6	Anglo-American Tel. Co., Ltd., Ord.	100	60 — 62
£3,118,210	Stk	35/-	Do. 6% Preferred Ordinary	100	107 —109
£3,118,210	Stk	2/-	Do. Deferred Ordinary ..	100	14⅛—14⅜
44,000	5	3/-	Chili Telephone Co., Ltd.	5	6½— 6¾
$15,000,000	$100	$2	Commercial Cable Co., Capital Stk.	$100	170 —190
£1,903,856	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	96 — 98
16,000	10	5/-	Cuba Submarine Tel. Co., Ld., Ord.	10	8¾— 9¼
6,000	10	10/-	Do. 10% Preference	10	17 — 18
6,000	5	2/-	Direct Spanish Telegraph Co., Ord.	5	3⅜— 3⅝
		5/-	10% Cum. Preference	5	8 — 8½
£30,000	50	4½%	Do. 4½% Debs...	50	100-102%
60,710	20	3/-	Direct U.S. Cable Co., Ltd... ..	20	11 —11½
£85,800	100	4½%	Direct West India Cable Co., Ltd., 4½% Reg. Debs.	100	99 —101
£300,000	100	4%	East. & S. African, Ld., 4% Mt. Dbs.	100	100—102
£200,000	25	4%	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)..	25	101-103%
300,000	10	2/6	Eastern Extension, Australasia and China, Ltd...	10	14 — 14½
£602,400	Stk	4%	Do. 4% Mort. Deb. Stk., Perp.	100	104 —106
£4,000,000	Stk	25/-	Eastern Tele. Co., Ltd., Ord. ..	100	140 —143
£2,000,000	Stk	17/6	Do. 3 % Pref.	100	89 — 91
£1,836,814	Stk	4%	Do. 4% Mort. Deb.	100	106 —108
150,000 3	10	5/-	Great Northern Telegraph Co., Ltd., (of Copenhagen) ..	10	30¾— 31¼
£58,700	100	4½%	Halifax and Bermudas Cable Co., Ltd., 4½% 1st. Mort. Debs. Red.	100	100—102
17,000	25	12/6	Indo-European Tele. Co., Ltd. ..	25	46 — 48
72,680	1	7½d.	Monte Video Telephone Co., Ltd., O.	1	13/16— 15/16
£1,983,333	Stk	6%	National Telephone Co., Ltd., Pref.	100	112—113
£1,966 667	Stk	5%	Do. Deferred	100	106—108
250,000	5	2/6	Do. 5% Non-Cum. 3rd Pref.	5	5½ — 5¾
£2,000,000	Stk	3½%	Do. 3½% Deb. Stk., Red. ..	100	98 —100
£689,593	Stk	4%	Do. 4% do. do. ..	100	104 —106
179,313	1	7½d.	Oriental Telephone & Elec. Co., Ltd.	1	1 1/16— 1 3/16
50,000	1	7½d.	Do. 6% Cum. Pref.	1	1 3/16 — 1 5/16
£100,000	100	4%	Pacific & European Tel. 4% Guar. Debs. Red...	100	98 —101
11,839	8	4/-	Reuter's Telegram Co., Ltd. ..	8	7¼— 7¾
58,000	5	3/-	United River Plate Telep. Co., Ltd.	5	7¾— 8¼
40,000	5	2/6	Do. 5% Cum. Pref.	5	5 — 5¼
£179,947	Stk	5%	Do. 5% Deb. Stock, Red. ..	100	106—108
15,609	10	4/-	W. African Telegraph Co., Ltd. ..	10	7¾— 8¼
£30,008	2½	—	West Coast of America, Ltd. ..	2½	5/16— 7/16
150,000	100	4%	Do. 4% Deb. Guar. by West.Tel.	100	99 — 101

TELEGRAPHS AND TELEPHONES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name	Paid up.	Closing Prices.
88,321	10	6d.	W.India&PanamaTeleg.Co., Ld., Or.	10	⅞— 1
34,563	10	6/-	Do. 6% Cum. 1st. Pref. ..	10	9 — 9½
4,669	10	6/-	Do. 6% Cum. 2nd Pref. ..	10	8¾ - 9¼
£80,000	100	5%	Do. 5% Deb.	100	102 —104
207,930	10	3/-	Western Telegraph Co., Ltd. ..	10	13½— 14
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	101 —103
518,945	Stk	4%	Do. 4% Deb. Stock, Red. ..	100	102 —104

VI.—SHIPPING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
32,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 5½% Cum. Pref.	10	8½— 9
£325,000	Stk	4½%	Do. 4½% Red. 1st Mort. Deb.Stk.	100	99 —101
£672,900	Stk	4½%	British & African Stm. Nav. (1900) Ltd., 4½% 1st Mort. Deb. Stk., Red.	100	93 — 95
40, 000	10	5/6	Bucknall Steamship Lines, Ltd., 5½% Cum. Pref.	10	6 — 6½
£600,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk.	100	74 — 77
£750,000	Stk	4½%	Clan Line Steamers, Ltd., 4½% Deb. Stk. Red. ..	100	98 —100
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000..	20	13¾— 14¼
40,000	20	8/-	Do. Nos. 60,001-100,000	10	6 — 6½
£464,430	Stk	4½%	Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. ..	100	101 —103
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord...	1	1 3/16—1 5/16
25,328	7½	4/7	Gen.Steam Navigation Co., Ld., Ord.	7½	4¼— 4¾
36,758	8	4/9⅗	Do. Non-Cum. 6% Pref... ..	8	7½— 8
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	99 —101
55,000	5	1/3	Houlder Line, Ltd., Ord.	5	2½— 3
40,000	5	2/9	Do. 5½% Cum. Pref.	5	3¼— 3¾
£200,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk. Red.	100	83 — 86
141,500	10	5/-	Leyland (Fredk.), & Co., (1900), Ltd., 5% Cum. Pref. ..	10	5¼ 5¾
£1,160,000	Stk	5 %	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. ..	100	130 —133
£1,160,000	Stk	19%	Do. do. Deferred ..	100	222 —225
15,000	100	30/-	Royal Mail Steam Packet Co. Ord..	60	25½ —26½
39,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref..	5	4¾— 5¼
39,075	5	2/6	Do. "B" Ord...	5	4 — 4½
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord..	10	8¼— 8¾
24,000	10	4/6	Do. 4½% Cum. Pref... ..	10	9¾— 10¼
£1,008,894	Stk	4%	Do. 4% Debenture Stk., Red.	100	99 —101

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
60,000	1	9⅗d.	Chadburn's (Ship) Tele. Ltd., Ord...	1	⅞— 1⅛
£750,000	Stk	5%	General Hydraulic Power Co., Ltd.	100	133 —138
12,500	10	10/-	Oakey (John) and Sons, Ltd., Ord..	10	24 — 26
10,000	10	6/-	Do. do. 6% Cum. Pf.	10	14 — 15
183,538	1	6·3d.	Power Gas Corp., Ltd., Ord., Nos. 66,463-250	15/-	5/16— 7/16
66,462	1	8·4d.	Do. do. Nos. 1 66,462	1	9/16— 11/16
135,000	1	6d.	Waygood (R.) & Co., Ltd., Ord. ..	1	1 1/16— 1 3/16
135,000	1	7½d.	Do. 6% Cum. Pref. ...	1	1⅛— 1¼

RAILWAY CARRIAGE & WAGON COMPANIES.

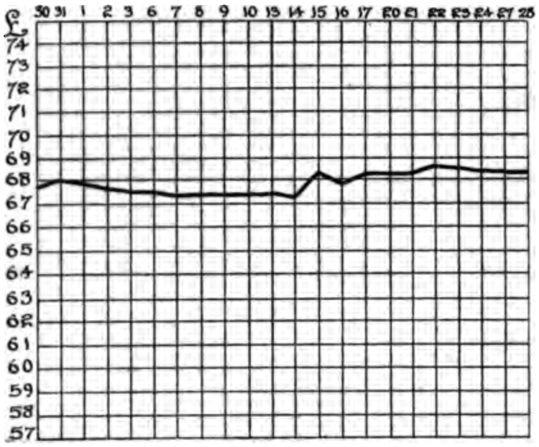
Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
10,000	10	7/6	Birm. Railway-Car. & Wagon, L., 1-10,000	10	20¾—21¼*
8,739	10	3/-	Do. Second Issue 1-8,739....	4	8¼— 8¾*
10,000	10	6/-	Do. Cum. Pref. 6% 1-10,000..	10	13 —13¼*
30,111	7	7/-	Gloucester Rail.-Car & Wagon, Ld., A, 1-29,861 & 49,751-50,000	7	9 — 9½
44,889	7	3/6	Do. B, 29,862-49,750, 50,001-75,000	7	4 — 4½
14,567	10	1/3	Lancashire Wagon, Ord.	2	2 3/16—2 5/16
4,150	10	5%	Do. do.	10	10½— 10¾
784,808	1	9d.	Metropolitan Amalgamated Rail.-Carriage & Wagon, Ld., 1-784,808	1	41 —42/
164,288	1	6d.	Do. Cum. A Pref. 5% 1-164,288	1	23/6 —24/6
235,000	1	7½d.	Do. Cum. B Pref. 6% 1-235,000	1	28/ —28/6
20,000	20	20/-	Midland Rail.-Car. & Wagon, Ld., 1-20,000	10	19 —19½

Stocks and Shares marked * are quoted ex-dividend.

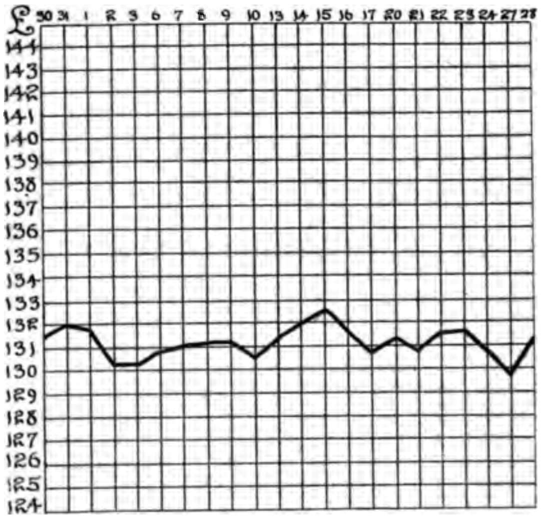
THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM JANUARY 30TH TO FEBRUARY 28TH, 1905.

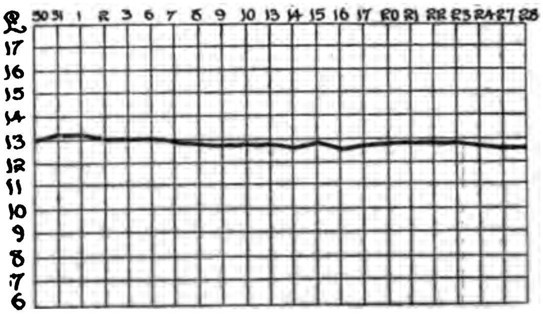
COPPER.



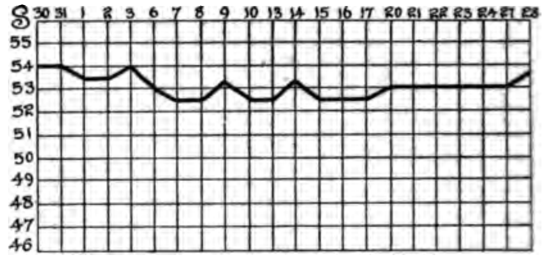
TIN.



ENGLISH LEAD.



PIG IRON: SCOTCH,



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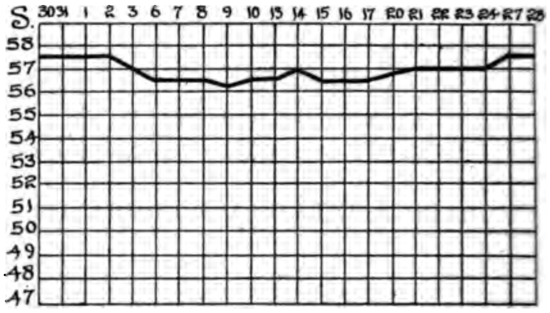
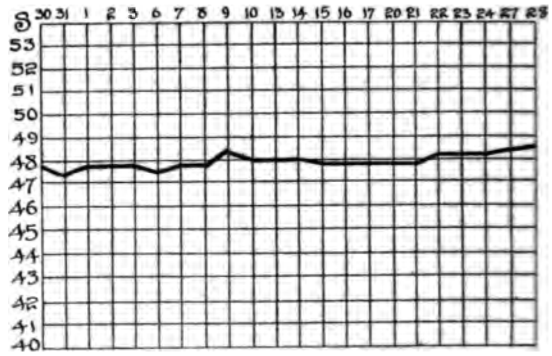
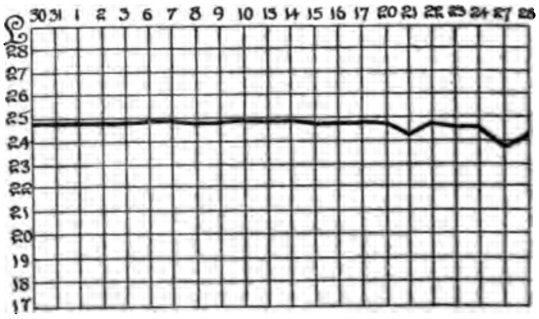


CLEVELAND.



SPELTER.



PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

MARKET REPORT.

Wednesday, March 1st, 1905.

COPPER has fulfilled the prediction made in this column by rising to a higher value. American advices have been very strong, and have materially assisted the advance in values. It is understood that consumers have allowed their stocks to run down to a low level, and if the market were subjected to manipulation copper might easily be put to £70. The statement is made that the Rio Tinto Company is sold out for immediate delivery, but with reckoning this a bull point it must not be overlooked that a good deal of copper is only held by speculators. Manufacturers are, however, fairly busy, and a survey of the whole position suggests the probability that we shall see a rising market for copper in the immediate future. The tone remains steady.

Tin has risen in sympathy with the advance in the price of the sister metal, the strength of copper having induced bear repurchases. There has been a certain amount of bear pressure for forward delivery, but spot tin has fallen away, owing to free offerings of metal, this, in its turn, causing a shrinkage in the backwardation for three months' delivery. The position is interesting. Merton and Company's report points out that statistics at the end of the month are expected to show a substantial decrease, while the Straits show little inclination for business at the present range of prices. The market looks like going higher.

The market for lead also shows improvement, some good buying having been witnessed, with the result of temporarily clearing supplies. The latest tendency, however, is towards an easier market, the quotations being, soft foreign £12 5s., and English £12 12s. 6d.

Spelter has had a sharp fluctuation. The price rose on orders from consumers, but the demand was freely met at the higher level, and finally prices reacted sharply.

The activity in other markets has been reflected on the pig-iron exchanges, and a large speculative business has been transacted. Middlesbrough iron has been strong on good American advices, and quotations at the close were 48s 8d. cash, and 48s. 11d. one month. Larger shipments of Cleveland iron to Scotland are to be noted.

IRON, STEEL, PIG-IRON, &c.

SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as follows. Prices delivered in Glasgow or equal :—

Steel:	£	s.	d.
Siemens' Steel Plates, Marine Boiler Quality	6	15	0
,, ,, ,, Land ,, ,,	6	17	6
,, ,, ,, Ship Quality Plates	5	17	6
Siemens' Steel Bars, Boiler Quality	6	17	6
,, ,, ,, Ship ,,	6	7	6
,, ,, Angles	5	7	6

Manufactured Iron:

	£	s.	d.
Bars—Dalzell	6	2	6
,, Best	6	12	6
,, ,, Horseshoe	6	12	6
,, Angle	6	2	6
,, Best Angle	6	12	6
,, Best Best	7	2	6
,, Extra Best	7	12	6

Usual terms and extras. Special rates for delivery in England and export. The above prices subject to alteration without notice.

The Glasgow Iron and Steel Co., Ltd., Wishaw, quote as under (prices are delivered Glasgow or equal) :—

	£	s.	d.	
Steel Angles (Glasgow ♔ Steel)	5	7	6	per ton.
Steel Ship Plates (Glasgow ♔ Steel)	5	17	6	,,
Steel Bars, Ship Quality (Glasgow ♔ Steel)	6	7	6	,,
Steel Bars, Boiler Quality (Glasgow ♚ ♚ Steel)	6	17	6	,,
Steel Land Boiler Plates (Glasgow ♚ ♚ Steel)	6	7	6	,,
Steel Marine Boiler Plates (Glasgow ♚ ♚ Steel)	6	7	6	,,

Less 5 per cent. discount. Extras as per standard list.

Special prices for delivery in England and for export. The above prices subject to alteration without notice.

John Spencer (Coatbridge), Ltd., Phœnix Ironworks, Coatbridge, N.B., quotes :—

	£	s.	d.
Bars—Phœnix	6	5	0
,, Best	6	15	0
,, Best Best	7	5	0
,, Extra Best	7	15	0
,, Best Horse Shoe	6	15	0
,, Extra B.H.S.	7	15	0
,, Extra Best Cable	8	5	0
,, Rivet	6	5	0
,, Best Scrap Rivet	7	5	0

	£	s.	d.
Angles—Phœnix	6	5	0
,, Best	6	15	0
,, Extra Best	7	5	0
Gas Tube Hoops—Phœnix Best	6	15	0
Plates—Phœnix	—		
,, Best Boiler	7	10	0
,, Best Best Boiler	8	0	0
,, Extra Best Boiler	9	0	0
Boiler Tube Strips—Phœnix Best Best	8	0	0

All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly.

Messrs. R. Feldtmann and Co., of Glasgow, quote Commission extra).

Pig Iron:

	No. 1.			No. 3.		
	£	s.	d.	£	s.	d.
Coltness, f.a.s. Glasgow	3	4	6	2	14	0
Gartsherrie ,,	2	19	0	2	14	0
Summerlee ,,	2	19	0	2	14	0
Carnbroe ,,	2	16	6	2	12	6
Langloan ,,	3	4	0	2	15	0
Calder ,,	2	19	0	—		
Clyde ,,	2	18	6	2	13	6
Glengarnock, f.o.b. Ardrossan	2	18	0	2	12	6
Eglinton ,, ,,	2	14	6	2	12	6
Dalmellington, ,, Ayr	2	14	6	2	12	6
Shotts ,, Leith	2	19	0	2	14	6

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, **at works:—**

	£	s.	d.
W.W. ♛ Bars	6	12	6
W.W. Best Bars	7	2	6
W.W. Best Best	7	12	6
W.W. Best Best Best	8	2	6
W.W. Best Shoe	7	2	6
Thornaby ♛	8	2	6
Thornaby Best	8	12	6
Thornaby Best Best	9	12	6
Whitwell Special Admiralty Cable	10	5	0
Special Chain Iron	9	5	0
Tube and Nail Strips	6	15	0
W.W. ♛ Angle Iron	6	15	0
W.W. Best Angle Iron	7	5	0
Tee Iron, to 8-inches United	7	12	6

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington, quote:—

		Iron.			Steel.		
		£	s	d.	£	s.	d.
♛ (BNF)	Bars	6	10	0	7	5	0
	Angles	7	0	0	7	5	0
	Tees	7	10	0	7	15	0
♛ W.I.W	Hoops	7	0	0	7	10	0
	Sheets	7	10	0	8	0	0

Ordinary Sizes, F.A.S. Liverpool in 10-ton Lots.
Extras for Sizes and Cutting as per List.

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

Black Sheets:	Singles 20 G 96in. by 36in. per ton.			Doubles 21 G to 24 G 96in. by 36in. per ton.		
	£	s.	d.	£	s.	d.
"Vale"	10	0	0	10	10	0
"Shield"	10	10	0	11	10	0
"Severn"	11	10	0	12	10	0
"Baldwin Wilden B."	12	10	0	13	10	0
Charcoal	16	10	0	17	10	0
Best Charcoal	18	10	0	19	10	0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:

	£	s.	d.	£	s.	d.
No. 3 Lead	13	10	0	14	10	0
S.V. Lead	15	0	0	16	0	0
No. 3 Terne	15	0	0	16	0	0
S.V. Terne	16	10	0	17	10	0

Tinned Sheets:	Singles 20 G to 108 by 36in. per ton.			Doubles 21 to 24 G to 96 by 36in. per ton.		
	£	s.	d.	£	s.	d.
Best Coke (Finish)	28	0	0	29	10	0
,, Charcoal (Finish)	30	0	0	31	10	0
Extra ,, ,,	32	0	0	33	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.

Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box.

Extreme sizes in Tin and Patent Coated specially quoted for.

Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.

At works less 2½% for cash monthly, 10th inst.

Galvanized Corrugated Sheets:

	£	s.	d.	
"Phœnix" Brand, 24 G., f.o.b. London, in Bundles	11	15	0	per ton.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	14	7	6	,,

Galvanized Working Up-Sheets:

	£	s.	d.	
24 G., f.o.b. London, in Bundles	13	15	0	per ton.

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£	s.	d.	
Crown Bars	6	10	0	per ton.
Best Bars (1 to 6in. wide, above ½ in. thick, ½ in. to 4 rounds and squares)	7	0	0	,,
Angles	6	15	0	,,
,, Best	7	5	0	,,
T's	7	0	0	,,
,, Best	7	10	0	,,
Best Shoe Iron	8	0	0	,,
,, Rivet Iron	8	0	0	,,
,, Best Rivet (Special)	9	5	0	,,
,, Cable	9	5	0	,,
,, Screwing	8	5	0	,,

	£	s.	d.	
Best Turning	8	0	0	per ton.
,, Plating	8	5	0	,,
,, ,, Best Best	9	5	0	,,
,, ,, Treble	10	5	0	,,
Plates	7	10	0	,,
Best Plates	8	0	0	,,
,, Boiler Plates	8	10	0	,,
,, Best Boiler Plates	9	10	0	,,
Treble Best Boiler Plates	12	0	0	,,

Delivery f.o.b. Liverpool, Birkenhead or Manchester.

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon., quote "Star" brand patent wrought nails, steel nails, &c.

Discounts—

45 per cent. off 1-inch to 3-inch strong rose and all fine rose and 6dy. and 8dy. pound.

40 per cent. off 3½ inch to 7-inch strong rose and 10dy. and 20dy. pound.

40 per cent. off all sharp-pointed nails.

Delivered in lots of 4 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis:—

2 tons 9/6 per cwt.
4 cwt. lots and upwards 9/9 per cwt. } d/d any Railway Station.

Steel cut nails, 3-inch basis—

2 tons 8/3 per cwt.
4 cwt. lots 8/6 per cwt. } d/d any Railway Station.

Slit rods (iron) £7 10s. per ton, at works for 2-ton lots.

Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E. C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla, quote:—

	Per Box. f.o.b. Wales. £	s.	d.
Coke Tin-plates.			
C 18¾ by 14 124s. 110 lb. "BV"	0	12	4½
C 20 by 10 225s. 155 ,, "Jumbo"	0	17	6
C 20 by 14 112s. 108 ,, "Lydbrook"	0	12	1½
C 28 by 20 112s. 216 ,, "Lydbrook"	1	4	6
Charcoal Tinplates:			
C 20 by 14 112s. 108 lb. "Allaway"	0	12	10½

BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes:—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

		£	s.	d	
Steel:					
Blooms	at	3	12	0	per ton.
Billets	at	3	14	0	,,
Sheet Bars	at	3	16	0	,,
Finished Steel:					
Bars	at	5	0	0	per ton.
Angles	at	5	1	0	,,
Tees	at	5	4	0	,,
Joists	at	4	10	0	,,
Fencing Standards	at	5	2	0	,,
Shoeing Bars	at	5	4	0	,,
Tyre Bars	at	5	4	0	,,
Half-Round Bars	at	5	5	0	,,
Heavy Rails	at	4	15	0	,,
Light Rails	at	4	17	6	,,

Structural Steelwork:

Prices on application.

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote:—

TIN.

Tin:	£	s.	d.		£	s.	d.	
English Ingots, f.o.b. Dis. 1¼% & 1%	130	10	0	to	131	0	0	per ton.
English Bars, f.o.b. Dis. 1¼% & 1%	131	10	0	to	132	0	0	,,
Straits G.M.B., cash Warehouse, Net	130	12	6	to	130	15	0	,,
Straits G.M.B., 3 months, Warehouse, Net	130	2	6	to	130	5	0	,,
Australian, Mt. Bischoff, Warehouse, Net	131	0	0	to	131	5	0	,,

COPPER.

Copper:	£	s.	d.		£	s.	d.	
Standard G.M.B., cash Warehouse, Net	68	6	3	to	68	7	6	per ton.
Standard G.M.B., 3 months, Warehouse, Net	68	12	6	to	68	13	9	,,
English, Tough, Cake & Ingot, Warehouses, Net	71	0	0	to	71	10	0	,,
English, Best Select, Warehouse Net	71	13	0	to	72	5	0	,,
English, Sheets and Sheathing, f.o.b., Dis. 2½%	80	0	0	to	80	10	0	,,
English Sheets for India, f.o.b., Dis. 2½%	75	0	0	to	76	10	0	,,
Electro, Warehouse, Net	70	15	0	to	71	0	0	,,
Ore, ex. ship	0	12	0	to	0	13	0	per unit.
Regulus, Matte and Precipitate, ex. ship,	0	13	3	to	0	14	0	,,

YELLOW METAL.

Yellow Metal:

	£	s.	d.	£	s.	d.	
Sheets, 4 by 4 feet for India f.o.b. Dis. 2½%				0	0	6¾	per lb.
Sheathing ,, ,,				0	0	6⅞	,,

SPELTER.

	£	s.	d.		£	s.	d.	
Silesian outports, Net	24	0	0	to	24	5	0	per ton
Blende of 50 % Net	6	16	6	to	7	0	0	,,
Calamine, Net	6	19	0	to	7	0	0	,,

LEAD.

	£	s.	d.		£	s.	d.	
English Pig, Warehouse, Dis. 2½%	12	10	0	to	12	12	6	per ton.
Spanish, ex ship, Dis. 2½%	12	5	0	to	12	10	0	,,
Lead Ore of 70 %, Net	6	4	6	to	—			,,

ANTIMONY.

	£	s.	d.		£	s.	d.	
Star Regulus, f.o.b., Dis. 2½ %	35	0	0	to	36	0	0	per ton.
Ore, 50 %, ex ship, Dis. 2½%	8	10	0	to	9	10	0	,,
Crude, ex ship, Dis. 2½ %	13	10	0	to	14	0	0	,,

QUICKSILVER.

	£	s.	d.	
Spanish, 75 lb., Warehouse, Net	7	12	6	per flask.
Italian ,, ,, ,,	7	11	6	,,

COAL.

LEICESTERSHIRE.

The Nailstone Colliery Company, Leicester, quote. Price per Ton at Pit of 20 Cwt., with ½ Cwt. per Ton for wastage —

Upper Main Seam.	s.	d.
Main Coal	7	6
Best Hard Steam (hand picked, as used by the Railway Companies)	6	0
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)	6	0
Fine Slack	0	6

Terms, net cash on 10th of month following delivery.

DERBYSHIRE.

The Manners Colliery Co., Ltd., of Ilkeston quote as follows, per ton at pit:

Kilburn Coal:	s.	d.
Best London Brights	9	9
Large Nuts (1½ to 3½)	9	6
Small Nuts (¾ to 1½)	6	0
Rough Brights	6	0
Peas (⅜ to ¾)	5	0
Slack	3	6
Smudge	2	0

Low Main (or Tupton) Coal:		
Low Main Brights	7	6
,, ,, Nuts	7	3
Hards (Good Steam Coal)	8	0
Bakers' Nuts (1" to 2")	6	6
Slack	3	6

The Clay Cross Company's Collieries, Clay Cross, near Chesterfield, quote:—

	per ton at pit. s.	d.
Best Main Coal	10	6
Best Silkstone	10	0
Best House Coal	8	6
Best House Nuts	8	0
Treble Screened Cobbles	7	9
Best Cobbles	7	3

NOTTINGHAMSHIRE.

The Digby Colliery Co., Ltd., near Nottingham, quote per ton at pit:—

Digby Coal:

STEAM.	s.	d.
Best Hand Picked Hard	9	0
Steam Hard	7	9
Hard Nuts	7	0

Gedling Colliery.

HIGH HAZEL.		
London Brights, 4 to 8 in. cube	12	0
Large Nuts, 2 to 4 in. cube	9	6
Small Nuts, ¾ to 2 in. cube	5	6

STEAM.—TOP HARD.		
Best Hard	9	0
Hard Steam	8	0
Cobbles	7	0

CHEMICALS AND OILS.

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square, Manchester, quote:

		£	s.	d.	
Acids:	Oxalic	0	0	2¼	per lb.
	Picric, Crystals	0	0	11	,,
	Tartaric .... at Manchester	0	0	10¾	,,

		£	s.	d.	
Acetate of Lime:	Brown at Manchester net	9	10	0	per ton.
	Grey ,,	11	10	0	,,
Alumina:	Alum, Lump, loose	5	5	0	,,
	,, ,, in casks	5	7	6	,,
	,, Ground, in bags	5	15	0	,,
	Sulphate of Alumina, 14%	4	10	0	,,
Ammonia:	Carbonate	0	0	3⅝	per lb.
	Muriate Grey f.o.b. Liverpool	24	0	0	per ton.
	Sal-ammoniac, Lump, 1sts, del^d. U.K.	42	0	0	,,
	,, ,, 2nds, ,,	40	0	0	,,
	Sulphate .... f.o.b. Liverpool	13	5	0	,,
Arsenic:	Best White Powdered ....net	12	5	0	,,
Bleaching Powder,	35% .... ,,	4	10	0	,,
Borax:	British Refined Crystal........ ,,	12	0	0	,,

Coal Tar Products:					
Benzole, 50/90 %	,,	0	0	6	per gal.
,, 90%	,,	0	0	7	,,
Carbolic Acid Crystals, 34/35° C. ...	,,	0	0	6	per lb.
,, ,, ,, 39/40° C. ...	,,	0	0	6¼	,,
,, ,, Liquid, 97/99 % ...	,,	0	0	9	per gal.
,, ,, Crude, 62½% at 60° F. f.o.b.	,,	0	1	9	,,
Creosote, ordinary good liquid......	,,	0	0	1¼	,,
Naphtha, Crude, 20 % at 120° C....	,,	0	0	8	,,
,, Solvent, 90% at 160° C. f.o.b	,,	0	0	8	,,
,, ,, 95 % at 160° C. ,,	,,	0	0	9	,,
,, ,, 90 % at 190° C. ,,	,,	0	0	10	,,
,, Rectified, flash point over 73° F. ....f.o.b.	,,	0	0	11	,,
,, Rectified, flash point over 100° F. ....f.o.b.	,,		1	0	,,
Naphthalene, all qualities.					
Pitch..............f.a.s. Manchester.	,,	1	11	6	per ton.
Copperas: Green, in bulk	,,	0	12	6	,,
,, barrels f.o.b. L'pool	,,	1	19	0	,,
Cake	,,	1	2	6	,,
Copper: Sulphate		22	15	0	,,
Cyanides: 98% minimum ......f.o.b.	net	0	0	8	per lb.

Lead:	Acetate (Sugar) White. English......	27	10	0	per ton.
	,, ,, ,, Foreign c.i.f. U.K	24	5	0	,,
	,, ,, Grey	21	15	0	,,
	,, ,, Brown at Manchester	17	0	0	,,
	Nitrate	24	0	0	,,
	Litharge, Flake	15	10	0	,,
	,, Powder	16	0	0	,,
	Red Lead, Genuine, c.i.f. London less 5%	15	10	0	,,
	White ,, ,, Dry ,, ,, ,,	16	15	0	,,
Naphtha (Wood):	Miscible, 60 o.p.	0	2	10	per gal.
	Solvent..	0	2	7	,,
Potash:	Bichromate... delivered England...	0	0	3	per lb.
	Carbonate, 90/92 % ... c.i.f Hull ...	18	10	0	per ton.
	Caustic, 75/80 % ...... ,, ,, ...	20	15		
	Chlorate ....net	0	0		
	Montreal.........in Store, Liverpool	35	0		
	Prussiate, Yellow ....net	0	0		

	£	s.	d.	
Soda: Ash, Caustic, 48 %, Ordinary .. net	5	5	0	per ton.
,, ,, ,, Refined...... ,,	6	5	0	,,
,, Carbonated, 48 %............ ,,	5	10	0	,,
,, ,, 58 % (Ammonia Alkali) ....net	4	10	0	,,
,, Bleachers' Refined Caustic 50/52 % .... net	6	10	0	,,
Caustic, White, 77 %............... ,,	10	10	0	,,
,, ,, 70 %............... ,,	9	12	6	,,
,, ,, 60 %.. .... ,,	8	12	6	,,
,, Cream, 60 %..... .... ,,	8	10	0	,,
Crystals, in bags	3	0	0	,,
,, barrels	3	7	6	,,
Acetate .... c.i.f. Hull net	16	15	0	,,
Bicarbonate, in 1 cwt. kegs............	6	15	0	,,
Bichromate......delivered England...	0	0	2¼	per lb.
Chlorate .... net	0	0	3 1/16	per lb.
Nitrate...ex quay Liverpool, ... ,,	11	7	6	per ton.
Phosphate	9	5	0	,,
Prussiate ....net	0	0	3⅝	per lb.
Silicate, Solution, 140° Tw.	4	10	0	per ton.
Sulphate (Glauber Salts)...............	1	12	6	,,
,, (Saltcake, 95%)...............	1	15	0	,,
Sulphur: Recovered	4	15	0	,,
Roll	6	15	0	,,
Flowers..................................	7	10	0	,,
Zinc: Sulphate	6	15	0	,,

MINERALS.

	£	s.	d.	
Barytes: Lump Carbonate, 90/92%	3	10	0	per ton.
Sulphate, No. 1, White............	2	15	0	,,
China Clay: of various qualities for all purposes; prices from about 11/- to about 30/- per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid.				
Chrome Ore: Basis 50% c.i.f. British Ports..........	3	7	6	,,
Manganese: Lump c.i.f. Liverpool 10¼d.				per metallic unit.
Ochre: French JC .... f.o.b. Rouen, net	2	5	0	per ton.
,, JF	5	10	0	,,
Talc: (French Chalk).........c.i.f. Liverpool	3	10	0	,,

OILS, etc.

	£	s.	d.	
Aniline Oil ....net	0	0	4¾	per lb.
,, **Salt**.......... .... ,,	0	0	4½	,,
Castor Oil: French, 1st pressure, f.o.b. Marseilles less 1¼%.........	22	15	0	per ton.
English, 1st pressure, f.o.r. Hull, less 2½%...............	23	5	0	,,
Cocoa Nut Oil: Ceylon, ex store Manchester...............net	29	10	0	,,
Cochin, ex store Manchester . ...net	32	0	0	,,
Cotton Seed Oil: Refined at Hull, less 2½% naked	14	7	6	,,
Edible...at Hull, less 2½% naked	14	17	6	,,
Glycerine: Crude, 80% .... net	31	0	0	,,
Linseed Oil: Raw... ..at Hull, less 2½% naked	15	2	6	,,
Boiled......at Hull less 2½% naked	16	2	6	,,
Starch: American Pearl...at Manchester, net	8	15	0	,,
Dextrine............ ,, ,,	18	0	0	,,
Farina............... ,, ,,	15	15	0	,,
Shellac: Standard TN orange spot		140/-		per cwt.
Turpentine: American.........at Liverpool	38	0	0	per ton.
Russian ....at Hull...net	19	0	0	,,

TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote:—

COLONIAL WOODS.

Timber.

		£	s.	d.		£	s.	d.
Quebec Square White Pine...	per cub. ft.	0	1	9	to	0	3	0
Quebec Waney Board Pine...	,,	0	2	8		0	3	9
St. John Pine, 18 in. average	,,	0	2	4		0	3	3
Lower Ports Pine...............	,,	0	1	3		0	1	8
Quebec Red Pine	,,	0	1	6		0	2	0
Quebec Oak, 1st quality	,,	0	2	9		0	3	4
Quebec Oak, 2nd quality ...	,,	0	1	6		0	2	6
Ash	,,	0	1	6		0	2	3
Elm	,,	0	3	3		0	3	10
Hickory	,,	0	2	0		0	2	6
Quebec Birch	,,	0	1	6		0	2	3
St. John Birch	,,	0	1	6		0	2	0
Birch Planks......................	,,	0	0	9		0	0	11
Spruce Spars	,,	0	0	10		0	1	0

Deals.

		£	s.	d.		£	s.	d.
1st quality Quebec Pine	per std.	22	10	0	to	32	10	0
2nd do. do.	,,	17	0	0		22	0	0
3rd do. do	,,	11	10	0		13	0	0
St. John, N.B., etc., Spruce	,,	6	15	0		7	5	0
Lower Ports Spruce..	,,	6	10	0		6	15	0
Spruce Boards.................	,,	5	10	0		6	0	0

UNITED STATES, etc., WOODS.

Pitch Pine.

		£	s.	d.		£	s.	d.
Hewn	per cub. ft.	0	1	4	to	0	1	8
Sawn	,,	0	0	11		0	1	6
Planks, Stowage	,,	0	0	10		0	1	0
Boards, Prime	per std.	12	10	0		16	0	0
Oak Timber	per cub. ft.	0	1	6		0	2	6
Oak Planks	,,	0	1	6		0	2	1
East India Teak..............	per load	12	0	0		16	0	0
Greenheart.....	,,	6	15	0		7	10	0

EUROPEAN WOODS.

Timber.

		£	s.	d.		£	s.	d.
Riga Redwood	per cub. ft.	0	1	6	to	0	2	0
Dantzic and Memel Fir, Crown	,,	0	2	1		0	2	6
Dantzic and Memel Fir, Middling	,,	0	1	9		0	1	11
Stettin	,,	0	1	9		0	1	11
Swedish........................ ...	,,	0	1	0		0	1	3
Riga Whitewood	,,	0	1	0		0	1	3
Norway Mining Timber	,,	0	0	9		0	1	0
Dantzic and Stettin, etc., Oak..	,,	0	2	6		0	3	0
Norway Spars.................	,,	0	1	2		0	1	9

Deals.

		£	s.	d.		£	s.	d.
Red Archangel and Onega, 1st quality	per std.	19	0	0		20	0	0
Red Archangel and Onega, 2nd quality	,,	14	0	0		16	0	0
Red Archangel and Onega, 3rd quality	,,	10	10	0		12	10	0
St. Petersburg, 1st quality...	,,	16	0	0		17	10	0
Do. 2nd ,, ...	,,	14	0	0		15	0	0
Gefle	,,	11	10	0		16	0	0
Wyburg	,,	11	0	0		12	10	0
Uleaborg	,,	10	0	0		12	10	0
Gothenburg	,,	11	0	0		16	0	0

SELECTED PATENTS.

Compiled expressly for this journal by **Messrs. Page and Rowlingson, Engineering Patent Agents, 28, New Bridge Street, London, E.C.,** and at Manchester.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton Buildings, Chancery Lane, W.C., at the uniform price of 8d.

NEW PATENTS APPLIED FOR.

When Patents have been communicated the names of the communicators are printed in italics.

20315a/04. S. H. Adams, Scotswood-on-Tyne. Feb. 15.—Improvements in penstocks and sluices. (Date applied for, Sept. 21st, 1904.)

28403a/04. E. Lines, London. Feb. 15th.—Improvements in and in manufactures for use and in connection with the treatment of sewerage and other liquids for the purification thereof.

2883. E, Parkes, Birmingham. Feb. 13th.—A composition for lining puddling and other furnaces in which pig or scrap iron is balled or melted, and for similar purposes.

2889. C. Dawe, Plymouth. Feb. 13th.—Improvements in oscillating steam and air engines.

2897. W. H. Luther, Glasgow. Feb. 13th.—Improvements in and relating to cranes and the like.

2903. A. E Trevithick, London. Feb. 13th.—Steam superheater for locomotive boilers.

2922. C. A. Allison, London. Feb. 13th—Improvements in triple valves for air-brake systems. (*A. B. Levy, U.S.A.*)

2923. C. A. Allison, London. Feb. 13th.—Improvements in valves for air-break systems. (*A. B. Levy, U.S.A.*)

2924. L. Haneke, London. Feb. 13th.—Improvements in wrenches.

2933. P. G. Tismer, London. Feb. 13th. — Automatic oiling device and alarm for engines. (Date applied for, April 4th, 1904.)

2941. W. S. Morgan, Kingston-on-Thames. Feb. 13th. An improved axle for automobiles. (Date applied for, Feb. 11th. 1904.)

2947. J. Badeker, London. Feb. 13th.—Improvements in metallic rod packings. (Date applied for, March 25th, 1904)

2951. R. Young and J. Yetton, London. Feb. 13th.—Improvements in or relating to internal combustion turbines.

2965. J. W. Wadkin and D. J. Jarvis, London. Feb. 13th.—Improvements relating to cutters for wood-working and other machines.

2973. E. Richardson, London. Feb. 13th.—A new self-controlled regulating and release exhaust valve for steam and other motive engines.

2984. K. Gossweiler, London. Feb. 13th.—Improvements in and relating to the manufacture of sheet metal vessels.

2997. J. T. and J. Taylor, Ltd., and W. G. Atkins, Batley. Feb. 14th.—An improved truck for use in connection with hydraulic presses.

3000. J. E. Lea, Glasgow. Feb. 14th.—Improvements in apparatus for measuring and recording the quantity of a stream of liquid flowing over a weir or through an orifice.

3006. E. Schofield, Brighouse. Feb. 14th.—An automatic navigator.

3011. J. McRae, London. Feb. 14th.—Improved device for locking nuts.

3015. T. Suzuki, London. Feb. 14th. — Improvements in furnaces.

3028. C. Walton, and G. H. Rayner, Seascale. Feb. 14th.—Improvements in and relating to machinery for drilling or cutting coal, rock or the like.

3031. P. A. W. Parkyn, and A. Allen, Manchester. Feb. 14th.—Improvements in superheaters for steam.

3039. E. Reynolds, London. Feb. 14th.—Improvements in steam engines.

3048. C. B. Luckman, Birmingham. Feb. 14th.—Improved means for preventing concussion in high pressure water pipes and fittings.

3050. R. F. Black and The Wilkinson Sword Co., Ltd., London. Feb. 14th.—Improvements in lock nuts.

3062. T. B. Pearson, London. Feb. 14th.—Adjustable expanding chain gear.

3064. A. Pomfret, London. Feb. 14th.—Improvements in or relating to apparatus for lubricating the cylinders and other parts of steam, gas, oil and petrol engines.

3096. J. E. Spagnoletti and A. Y. Hutchinson, London. Feb. 14th.—An improved engineer's tool for ruling, gauging, levelling and other operations.

3097. P. M. Justice, London. Feb. 14th.—Improved means for locking nuts. (*The American Lock Nut Co., U.S.A*)

3099. A. J. Howard, Leicester. Feb. 15th.—Improvements in feed-water heating devices for steam boilers.

3175. A. M Nicholas, London. Feb. 15th.—An improved rotary filtering apparatus for the separation of liquids or solutions from tailings, slimes, sewage, and the like.

3176. A. Aitchison and D. Upton, London. Feb. 15th.—Improvements in apparatus for moving articles in relation to the rolls of rolling mills.

3178. J. Hopkinson and Co., Ltd., and J. Hopkinson, London. Feb. 15th.—Improvements in valves and cocks.

3180. E. G. Harris, London. Feb. 15th.—Improvements in and relating to centrifugal pumps.

3187. C. Baxter and A. Eavold, London. Feb. 15th.—Improvements in or connected with starting and driving mechanism suitable for use with gas engines, electro-motors, and other engines.

3199. A. C. Jackson, London. Feb. 15th.—New or improved nut lock.

3206. S. R. Stone, London. Feb. 16th—An improved manhole cover (airtight).

3210. A. T. Cass, Keighley. Feb. 16th.—Improvements in grate-bars for the furnaces of steam generators and the like.

3215. J. L. Dunn and A. Dunn, Liverpool. Feb. 16th.—Improvements in or connected with furnaces, more particularly applicable to steam generators.

3229. W. J. Crossley and A. V. Coster, Manchester. Feb. 16th.—Improvements in the method of cooling the piston-rods and pistons of internal combustion engines.

3246. F. Windhausen, Junr, London. Feb. 16th.—Improvements in variable speed multiple stage turbines. (Date applied for, Feb. 18th, 1904.)

3258. E. C. Harvey, London. Feb. 16th.—A new or improved tool or machine for screwing up nuts or bolts, driving screws and performing like operations.

3268. J. N. Russell, London. Feb. 16th.—Improved method of and means for heating buildings by the circulation of steam or vapour.

3286. V. Schwaninger, London. Feb. 16th.—Improvements in means for operating valves or cocks by means of floats.

3288. The Warwick Machinery Co., Ltd., and F. Samuelson, London. Feb. 16th.—Improvements in and relating to throttle-valves.

3302. N. L. Tullis, Glasgow. Feb. 17th.—Improvements in and connected with driving belts.

3309. J. Knowles, J. Rimmer and W. Liptrot, Manchester. Feb. 17th.—Improvements in metallic joint rings.

3319. J. A. Davenport, London. Feb. 17th.—A device for obtaining a variable speed gear for driving rotative pieces of any description, number of variations unrestricted.

3320. G. E, Charlesworth and W. Charlesworth, Sheffield. Feb. 17th.—Improved pedestal bearings for axles of colliery corves, mineral wagons and the like vehicles.

3331. J. Stanton, Junr., Chorley. Feb. 17th.—Improvements in the construction of engines, so that exhaust steam or vapour may be used for generating further steam or vapour for driving purposes or otherwise.

3357. C. A. Vandervell and W. Hodgson, London. Feb. 17th.—Improvements in and relative to means for driving dynamos and the like.

3359. Fraser and Chalmers, Ltd., London. Feb. 17th.—Improved means for securing parts to shafts, such as tappets to the stems of stamp mills. (*F. H. Millhouse and W. McFarlane, Transvaal.*)

3366. A. W. Herrick, London, Feb. 17th.—Improvements in traction attachments for vehicles. (Date applied for. July 13th, 1904.)

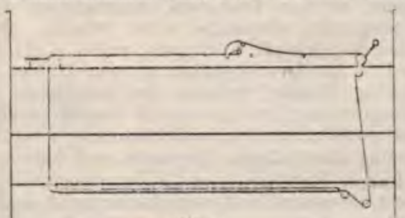
3367. H. G. Nye, London. Feb. 17th.—Improvements in tools and dyes for cutting screw threads.

3368. Lobel (Louis) Wechselmann, Siegfried, Konigsberger and E. Freudenthal, London. Feb, 17th.—Improvements in or relating to means for supporting miner's cages, skips and other elevators.

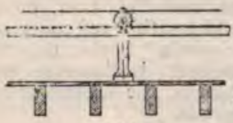
RECENT SPECIFICATIONS.

GRAIN CONVEYERS.

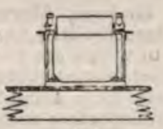
Robert Boyd, Ltd., and T. Stevens, both of Bury St. Edmunds. April 20th, 1904. This invention relates to improvements in the arrangement and construction of machinery for conveying barley, malt, or other grain or substances, in malt-houses, warehouses, and stores. The invention refers particularly to the construction known as band conveyers. In the upper part of a warehouse or store is constructed a frame, which supports rollers placed at suitable distances apart, upon which the carrying band travels. On each side of the band, rails of iron or wood are fixed upon which may be placed a throw-off carriage fitted with rollers to deflect the carrying band, for the purpose of delivering the grain or other substance by the momentum attained into suitably-placed spouts or shoots. The carriage can be fixed or clamped to the rails at the spot where the delivery of the grain or other substance is desired. Consists further of an arrangement by which the return band is carried in a trough-shaped box, fixed under the bins, upon the bottom of which the carrying band slides, no rollers being required. Spouts from the underside of the bins deliver the grain on to the band, which is carried forward and discharged into a hooper or other receptacle by a suitable arrangement of pullies. The trough or box upon which the band-slides prevents the grain or other substance which it is conveying, from being spilt. The box or trough may be fitted with a cover tray if desired.



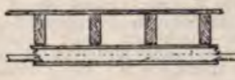
— FIG 1 —



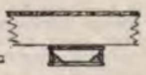
— FIG 2 —



— FIG 3 —



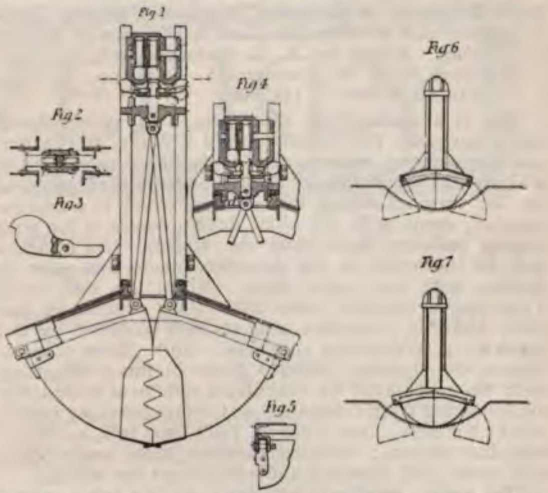
— FIG 4 —



— FIG 5 —

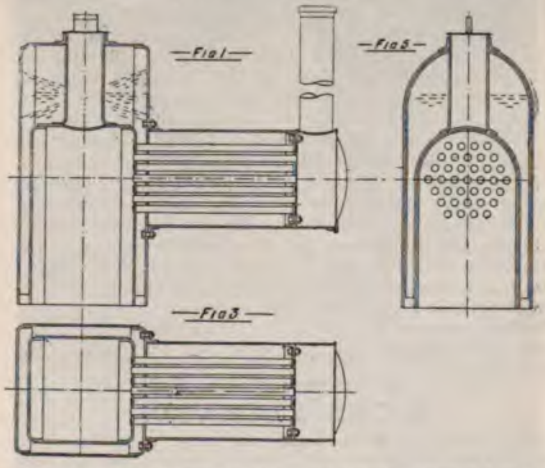
GRABS.

The Thames Ironworks, Shipbuilding and Engineering Company, Ltd., and G. J. Hone, of Canning Town, E. Dec. 23rd, 1904.—Relates to improvements in grabs of the kind described in the previous specification, No. 20,975 of 1894, the object being to improve the efficiency of such apparatus. The chief feature of the invention comprises novel gear for discharging the grab automatically at any desired point without the employment of the discharging-ring, lever, tumbler-pin, or oil-cylinder described in the aforesaid specification. In the novel gear the vertical pin attached to the crosshead is provided with one or more lateral slots or notches with each of which engages a pawl or catch loosely mounted on a hinge-pin held in the sheave-block, and each of which also loosely carries a balance-weight. The pawl and the balance-weights are made with co-acting faces, whereby the said pawls are prevented from falling into a position below the plane of the bottom of the balance-weights, but are not confined in their upward movement. The balance-weights normally tend to hold the pawls in their uttermost position, and fixed stops are provided on the frame of the grab to relieve the said pawls from the weights when the former are to engage with the notches in the pins. A further feature of the invention consists in attaching the buckets to the grab-frame by means of external hinges. By this means, not only is it possible to employ short hinge-pins, but the extent to which the grab can be opened is materially increased.



STEAM BOILERS.

E. S. Hindley, L. A. Hindley, H. D. Hindley and W. Stanford, all of Bourton, Dorset. March 15th, 1904.—The present invention has reference to steam boilers of the locomotive type, particularly those used for motor wagons and similar vehicles, and for launches. According to this invention provision is made for maintaining the normal water level above the barrel portion of the boiler, thereby shortening the water line beneath the steam space and above the fire-box, thus enabling the engine to be used on steep inclines without causing any part of the internal fire-box or tubes to be uncovered with water. This is effected by placing the barrel of the boiler as low down as possible and extending the external fire-box or casing a sufficient distance in an upward direction above the level of the top of the said barrel. The internal fire-box is placed low down within the external fire-box so as to give ample room for water and steam space above it, there being no steam space whatever above it, there being no steam space whatever within the barrel. In order to permit of the internal fire-box being placed as low as necessary arrangements are made for feeding the same from the top or near the top instead of from below, which latter is inconvenient in motor wagons and launches. The barrel and the external fire-box may be detachably secured together so that the former may be easily removed for cleaning or other purposes without disarranging the rest of the boiler.



NEW PUBLICATIONS.

"THE MINING YEAR BOOK 1905."

With Directory of Directors, Secretaries, Mining Engineers and Metallurgists, and a Glossary of Mining Terms. Edited by A. N. Jackman, with an introduction by J. W. Broomhead. Published by "The Financial Times." 15s. net.

This is a work which should be in the possession of every investor, the information it contains is reliable, and the general arrangement to facilitate reference is all that can be desired. Mr. Broomhead is responsible for the very informing introduction, which in a concise manner, deals with the chief developments of the gold mining industry throughout the world. Our readers will be interested in the departure made this year in dealing with the output item. Since the war, most Transvaal companies have made their returns in fine gold, and this procedure was recently adopted by the majority of Westralian concerns. Under these circumstances the statistics hitherto given in this publication, have been replaced by a tabulated statement embracing the following comprehensive particulars covering recent years: tonnage of ore crushed, yield from mill, average; total fine ounces; working revenue, costs and profit—total under each heading, and amount per ton milled.

The entire work is arranged on the index plan; mining, finance, exploration and allied companies are grouped in alphabetical order, and details concerning each company are placed under distinctive headings. The several valuable sketch maps of gold-producing countries have been brought up-to-date in matter of railway construction, etc., and the general utility of the glossary of mining terms has been greatly enhanced by the inclusion of French and German equivalents of the words defined.

"ENGINEER'S VALUING ASSISTANT."

Being a practical treatise on the valuation of collieries, and other mines, with rules, formulæ, and examples, also a set of valuation tables calculated on the principle of allowing interest to a purchaser of any annuity, benefit, or income, derived, or to be derived from mines or otherwise, at one rate of interest and redeeming the capital invested at another practical rate of interest, and table of value showing the discrepancies existing in the ordinary tables of present values and the errors created by them. By H. D. Hoskold, with an Introductory Note by the late Peter Gray, Second Edition. Longmans, Green and Co. 7s. 6d.

As pointed out in the introductory note, this work on the valuation of mineral property, contains matter of great interest for both the professional valuer and the actuary; for the former in its ample discussion of the principles which should guide him in the discharge of his duties, and for the latter in its treatment of problems which arise in the practical application of those principles. The accuracy of the principles laid down by the author have been scientifically demonstrated by the late Mr. Peter Gray.

BOOKS RECEIVED.

A Pocket Book of Marine Engineering Rules and Tables, for the Use of Marine Engineers, Naval Architects, Designer's Draughtsmen, Superintendents, and all engaged in the design and construction of Marine Machinery, Naval and Mercantile. By A. E. Seaton and H. M. Rounthwaite. Charles Griffin and Co. Ltd.

The Journal of the Iron and Steel Institute. Vol. LXVI. Edited by Bennett H. Brough. E. and F. N. Spon.

Sell's Directory of Registered Telegraphic Addresses. Henry Sell. 18s. and 21s.

Practical Electric Light Fitting. A Treatise on the Wiring and Fitting-Up of Buildings. Whittaker and Co. 5s.

NEW CATALOGUES.

Messrs. D. Mitchell and Co. Ltd., of Keighley, forward a useful blotter with celluloid cover. This incidentally calls attention to the firm's radial drills, and shows an interesting selection of these machines.

"Reed Tools," the title of Catalogue F issued by the Fairbanks Company, 78—80, City Road, E.C., is rendered on the cover in vermilion lettering on a dark grey ground with block bordering and ornamentation and at once attracts the eye. This catalogue is devoted to stocks with solid dies, stocks with adjustable dies, pipe vises, combination vises, pipe cutters, pipe cutter wheels, pipe taps, pipe reamers, combination drill and tap, combination pliers, etc,, and shows decided originality. Its aim is to prove the truth of the claim put forward on the title-page in the words, "If you don't say 'Reed,' you don't get 'the best,'" a sentence which is repeated on almost every page throughout the catalogue.

In Bulletin No. 5 the Abner Doble Company, engineers, of San Francisco, illustrate and describe their tangential ellipsoidal water wheels. Bulletin No. 6 is a paper by H. C. Crowell, and G. C. D. Leoth, entitled "An Investigation of the Doble Needle Regulating Nozzle," printed by permission of the Civil Engineering Department of the Massachusetts Institute of Technology, and containing a number of interesting illustrations, diagrams, and tables.

Messrs. Joseph Robinson and Co., engineers and iron-founders, designers, and manufacturers of machinery for rubber and gutta-percha, and bleaching, dyeing, and finishing machinery, of Springfield Lane Iron Works, Salford, Manchester, forward leaflets giving lists of their manufactures.

Messrs. Graham, Morton and Co., Ltd., have issued an attractive little booklet with a red cover, upon the front of which are the words "Pocket this Nugget." and an embossed gold nugget. It illustrates, by means of some forty small blocks, the subject of handling and transporting materials.

MEETINGS FOR THE ENSUING WEEK.

FRIDAY, MAR. 3.—Royal Society, 9 p.m.: Lecture, Mr. G. Marconi, "Recent Advances in Wireless Telegraphy."—Liverpool Motor Show opens.—North-East Coast Institution of Engineers, Newcastle.—Junior Insitution of Engineers, Westminster Palace Hotel, 8 p.m.: Paper, "Possible Improvements in Locomotive Practice," Mr. Walter Longland, M.I.Mech.E.—Geologists' Association: Paper, "The Diamond Mines of South Africa," Professor H. A. Miers University College, Gower Street, 8 p.m.

SATURDAY, MAR. 4.—Glasgow Technical College Scientific Society, 7.30 p.m.: Paper, "Steam Generators and their Failures," Mr. Geo. Ness, M.I.Mech.E.

MONDAY, MAR. 6.—Institute of Marine Engineers, Romford Road Stratford, 8 p.m.: Fuel Testing.—Society of Engineers Royal United Service Institution, 8 p.m.—Society of Arts: Cantor Lecture, 8 p.m., "Internal Combustion Engines," Mr. Dugald Clerk.

TUESDAY, MAR. 7.—Royal Institution, 5 p.m.: Paper, "Some Recent Biometric Studies," Professor K. Pearson.—Zoological Society, 8 p.m.

WEDNESDAY, MAR. 8.—Automobile Club: Annual Meeting.—Geological Society of London, 8 p.m.—Society of Arts: Ordinary Meeting, 8 p.m.—Liverpool Engineering Society: Paper, "The Evolution of Harbour Engineering," Mr. A. F. Fowler, M.Inst.C.E.

THURSDAY, MAR. 9.—Royal Society, 4.30 p.m.—Royal Institution, 5 p.m.: Paper, "Recent Astronomical Progress," Professor H. H. Turner.—Institution of Electrical Engineers, Great George Street, S.W., 8 p.m.—Dublin Electrical Engineers, Royal College of Science, Dublin, 8 p.m.

FRIDAY, MAR. 10.—Rugby Engineering Society, 8 p.m.: Paper, "The Minute Structure of Metals," Mr. J. T. Milton.—Physical Society.—Royal Society.—Royal Institution: Paper, "Structure of the Atom," Professor J. J. Thompson, F.R.S.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

VOL. VI. LONDON, FRIDAY, MARCH 10, 1905. No. 26.

The Offices of "Page's Weekly," Wednesday Evening.

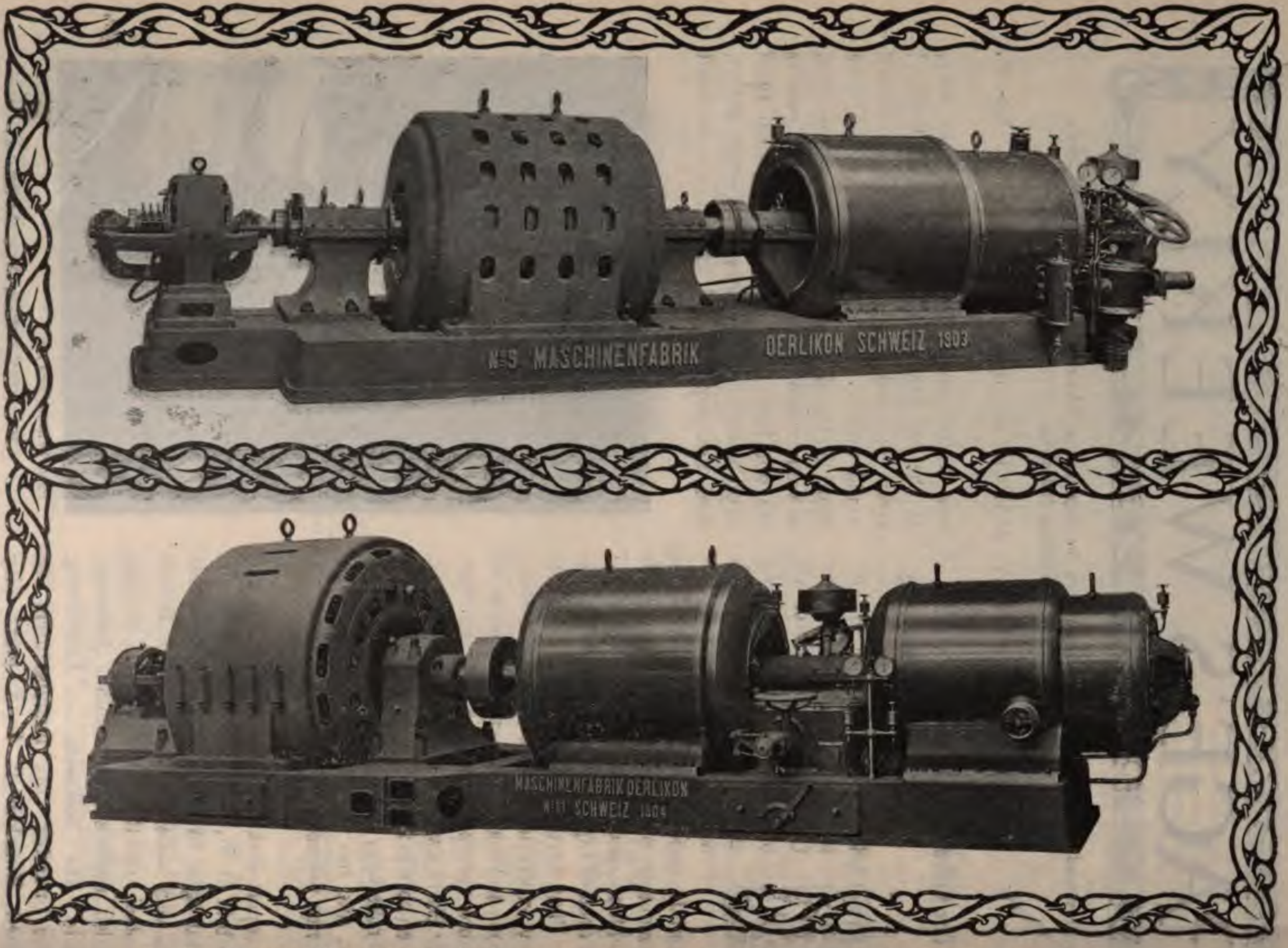
EARL CAWDOR, who is succeeding Lord Selborne as First Lord of the Admiralty, will bring an excellent business experience with him into his new office. His most important public appointment hitherto has been the chairmanship of the Great Western Railway, in which capacity since 1895 he has exhibited a decided capacity for commercial affairs. The new First Lord has had not a little Parliamentary experience, having sat in the House of Commons as Viscount Emlyn for some eleven years before succeeding to the title in 1898. Politically Earl Cawdor is comparatively young, having been born in 1847. He is Lord Lieutenant of Pembrokeshire, an Ecclesiastical Commissioner, and has served on the Carmarthenshire County Council.

In his report just presented on the iron and steel exhibits at St. Louis, Mr. E. S. Bell, our commercial agent in the United States, is able to give a very satisfactory account of British iron and steel exhibits, but he laments the fact that British engines were a minus quantity. We quote the following: "Considering the large number of manufacturers in the United Kingdom it is a great pity that no one could see their way to furnish an example of British skill. The question was asked, and probably more than once, at the St. Louis Exhibition, 'Has England given up making engines?' It certainly would appear so to those visitors who have heard of the British reputation and who seek in vain for some example to prove that reports are not false. The plea that the high tariff is prohibitive, though true to a certain extent, does not apply in all cases . . . It must

Photo by Elliott and Fry.]

MR. JOHN GAVEY, C.B., M.INST.C.E.,
Engineer-in-Chief to the Post Office,

Who opened the discussion on the Murray System of Machine Telegraphy at the Institution of Electrical Engineers last week.



RECENT TURBINE INSTALLATIONS (IV.)—TURBO-GENERATORS BY THE MASCHINENFABRIK OERLIKON, ZURICH.

(1) The upper picture shows a "Three-phase Turbo-Generator or 250 kilowatts, 3,000 revolutions per minute." The photo. represents the normal type of these machines for outputs varying between 100 to 500 kilowatts. The steam turbine consists of a single cylinder and is coupled directly to the generator by means of an elastic coupling. Turbine, generator and exciter are mounted upon a common bedplate. The bearings of the turbine are placed outside the steam chamber and are lubricated the same as the bearings of the generator, by means of a rotary pump.

(2) Below is shown a "Three-phase Turbo-Generator for 700 kilowatts, 1,500 revolutions per minute." This view represents the type employed for 600 kilowatts, and The turbine is divided into a high-pressure and a low-pressure cylinder, in order to allow the bearing to be placed outside the steam chamber and to be easily accessible.

be remembered that in sending exhibits to an exhibition like that of St. Louis it is an advertisement to the whole world. Visitors from South America and other countries, of which there are immense numbers, look for articles they require, and not only for new ideas. When they see what they want made by America, Germany, France, and others, they naturally buy from them in preference to the United Kingdom, whose manufactures they cannot see. It appears too much to the visitors as though British manufacturers had given up the fight in favour of other countries. The uninformed look upon it as a sign of weakness, while other countries make the most of their opportunities and encourage buyers in their belief."

That orders are not looked after by British manufacturers as they might be is instanced by a conversation Mr. Bell had with a representative of an American concern working under British patents. This representative declared that he had received personal inquiries from visitors from Europe for some of their manufactures. He had to refer them to the British house, which was unrepresented at the Exhibition, as his company is prohibited from selling in Europe. This is quoted by Mr. Bell to show how easily orders may be lost when a comparatively small outlay would show the goods to the world. As we all know, there is another side to this question, and when we reflect upon the number of British ideas which have been exploited in the States, the diffidence of British manufacturers is more easily understood.

A somewhat belated report of the students' address, delivered by Mr. James Swinburne, on "The Theory of Electricity and the Value of its Study to Engineers" has just come to hand from the Institution of Civil Engineers. Needless to say, Mr. Swinburne makes out a very good case for the study of electricity, pointing out, first of all, that it is the best example of the application of a large number of branches of mathematics. Probably this one subject, the theory of electricity, is the best study for those who wish to learn mathematics through physics, and to gain at the same time a knowledge that is the foundation of an important industry.

In the course of his remarks on the new theory of the constitution of matter, he remarks that what is urgently needed is a treatise which begins by assuming the existence of electrons, and gives a clear account of what the author conceives them to be, and then proceeds to show how they explain phenomena, and unravel all sorts of tangles, and open all sorts of stage doors of which the hypothesis is the unexpected master-key. As to the direct benefits to be derived from a study of electricity, Mr. Swinburne makes it evident that a modern engineer cannot consider his technical equipment complete without it.

"Electrical engineering," he says, "has not been developed by engineers with some knowledge of electricity, but by electricians and other people who have often had very little knowledge of engineering. The early dynamos were made by opticians. The early gramme rings were driven on to wooden hubs; and for a long time the field-windings were painted red, because it looked like sealing-wax varnish. Opticians used sealing-wax varnish first as an insulator, until it came to give the correct scientific look to all electrical instruments, just as badly designed hand-finished brass-work with hand-chased screws is necessary in other scientific instruments. As dynamo machines got larger they came more into the hands of engineers. In fact, engineers owe a great deal to the dynamo. It was the dynamo that produced the steam turbine. The Parsons turbine for marine propulsion would probably never have existed if the inventor had not begun on the dynamo. The modern high-speed engine also owes its existence largely to the dynamo."

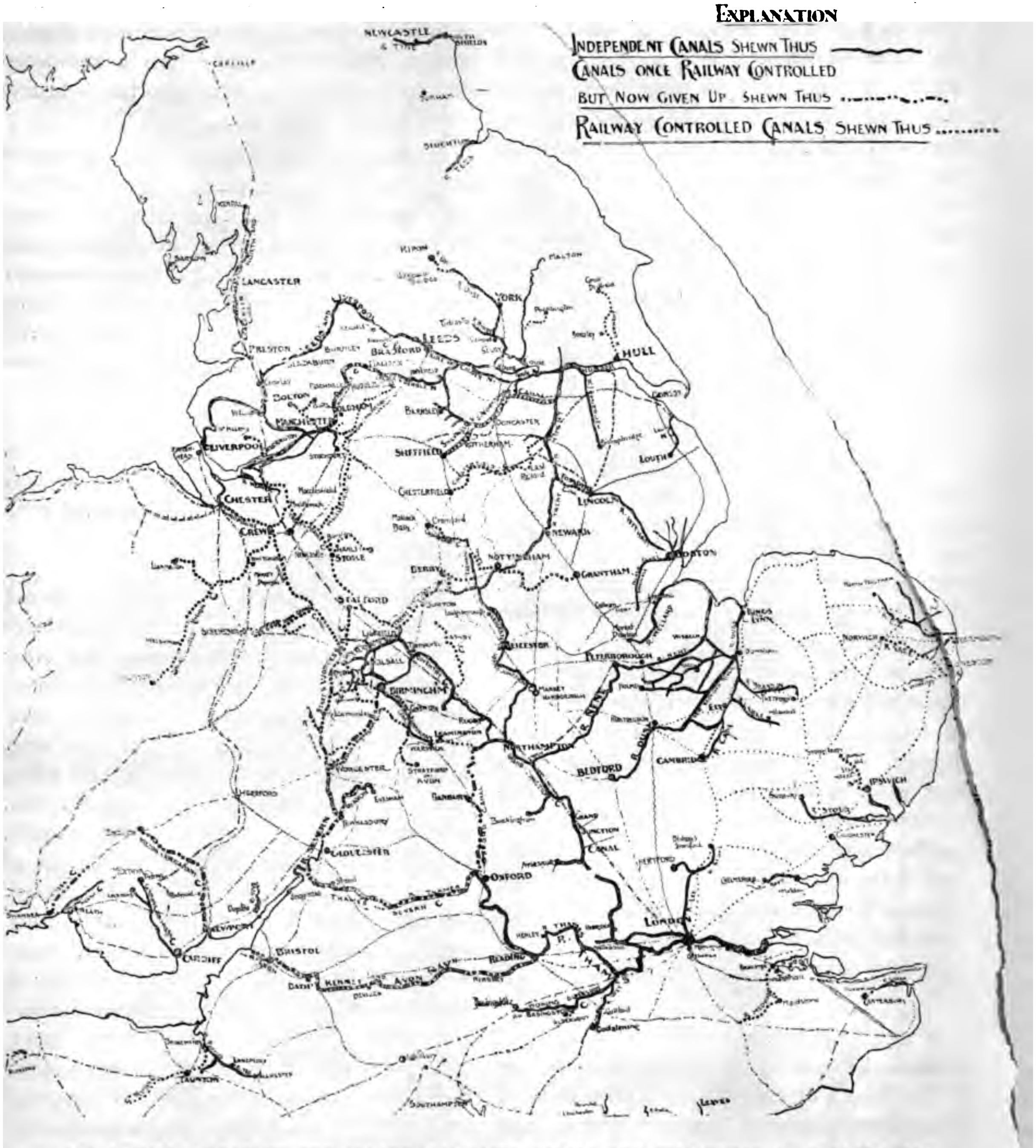


FIG. I. SKETCH MAP OF THE INLAND NAVIGABLE CANALS AND WATERWAYS IN ENGLAND AND WALES, SHOWING THE WATERWAYS UNDER, AND INDEPENDENT OF, RAILWAY CONTROL.

(*See page* 534.)

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

DAVIDGE PAGE, Editor.

Clun House, Surrey Street, Strand, London, W.C.
Telephone No: 3349 GERRARD.
Telegraphic and Cable Address: "SINEWY, LONDON."

Editorial.—*All communications intended for publication should be written on one side of the paper only, and addressed to "The Editor."*

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The Editor does not hold himself responsible for the opinions expressed by individual contributors, nor does he necessarily identify himself with their views.

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New Copy for Advertisements,

Alterations, &c., intended for insertion in the current week's issue must be delivered **not later than 4 p.m. on Monday.** If proofs are required the copy and blocks should reach us several days earlier.

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NEWS ITEMS.

Lord Selborne, the new High Commissioner for South Africa, will sail for the Cape by the Union Castle steamship *Walmer Castle* on April 29th.

What is claimed to be the first spinning mill in England built from the outset to be driven electrically is being erected by the Acme Spinning Company, of Pendlebury, near Manchester.

A valuable report has been issued by the Engineering Standards Committee on the experimental work which has been carried out for that committee at the National Physical Laboratory on the temperature rise in the field coils of electrical machinery. The work has been ably carried out by Mr. E. H. Rayner under the direction of Dr. Glazebrook.

On stand No. 20 at the Liverpool Motor Show, Messrs. John Gibbs and Son, ventilating and electrical engineers Duke Street, Liverpool, are exhibiting their new "Peerless Blower," direct driven by their patent dust-proof motor, adaptable for blowing forges or removing dust from polishing wheels. They are also showing a variety of electrically driven ventilating fans and an ingenious patent quick-break safety-starting switch.

A gentleman who says he has been twenty years in the navy and is "getting on in years, so naturally has a tired feeling after hard work," contributes his experiences in an advertisement for the benefit of a certain cocoa firm as follows: "Whilst cruising the other day, *one of the blades of our propeller came off, and I had to go and solder a spare one on. It was rather a long and tiring job,* and I sincerely believe if it hadn't been for ——— cocoa, I should never have got through it." We should think not, indeed!

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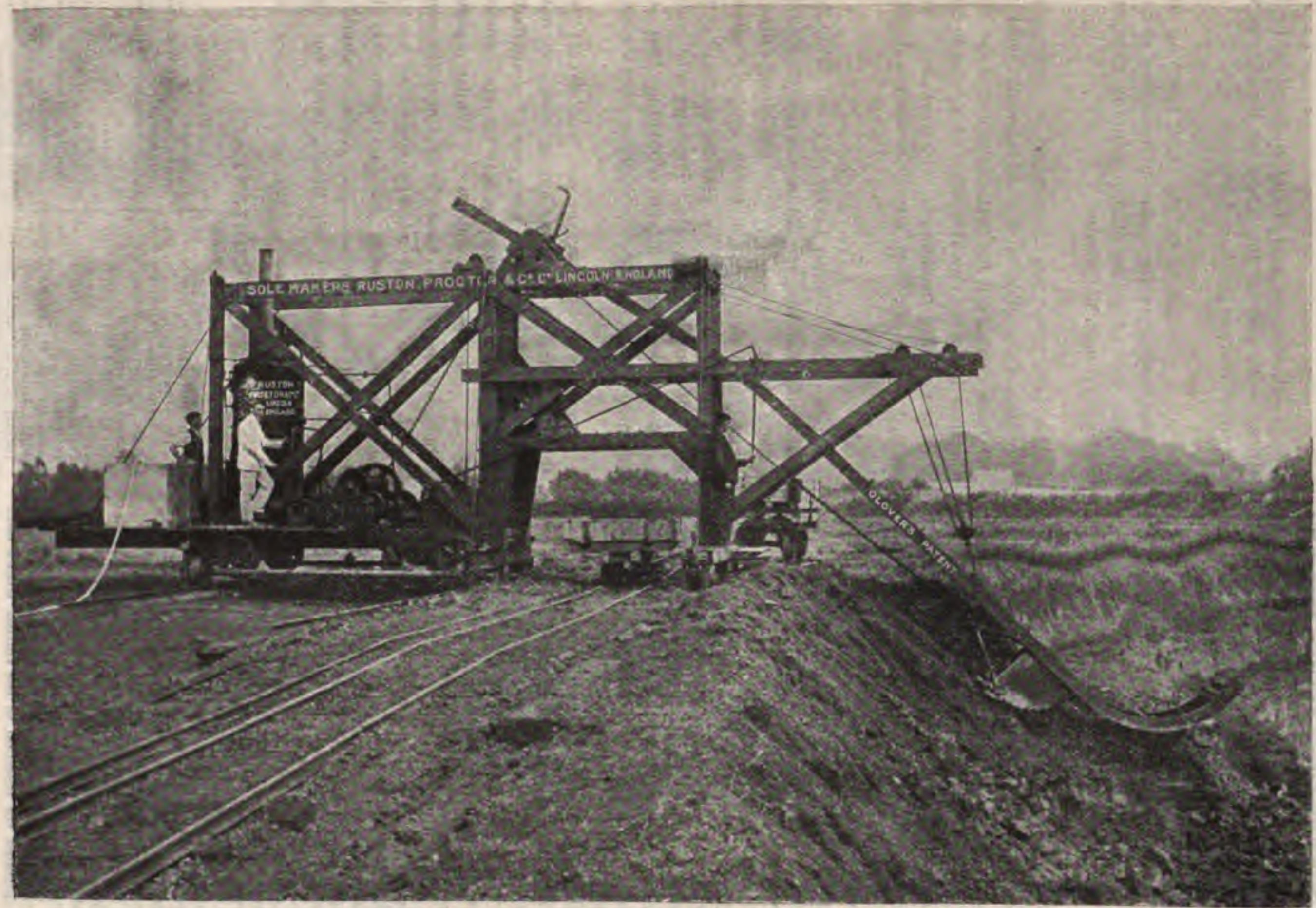


SPECIAL LADDER EXCAVATOR (GLOVER'S PATENT).

BY MESSRS. RUSTON, PROCTOR AND CO., LTD., LINCOLN.

Special Ladder Excavator (Glover's Patent), by Messrs. Ruston, Proctor and Co., Ltd., Lincoln.

In this excavator the ladder is pivoted at its upper end, and can be raised or dropped at its lower end to any required angle. It is constructed of two channel irons, strongly braced together, and in them runs a trolley, which forms the back of the bucket. The chain is attached to the bucket, and the resistance therefore of the material excavated, to the bucket teeth is met in the most direct manner by the chain, and with the least possible strain on the framing of the machine, whilst the ladder forms a sort of an abutment which keeps them firmly up to their work. The bucket is of one half cubic yard capacity, and is constructed in two parts, hinged together, viz., the back with the trolley wheel mentioned above, and the body carrying the cutting teeth and edge. The bucket, when at work, is lowered to the foot of the ladder, which is then dropped slightly, so that the teeth can get a grip, the clutch of the main engine is next thrown into gear, and the bucket hauled up, cutting a slice off the face of the bank on its journey; when it has reached the top of the ladder a trigger lever engages the back part and holds it, until it is again ready for lowering, at the same time the winding chain is slackened slightly by reversing the engine, causing the bucket body to swing forward, away from the back and discharge the excavated material. The chain is then tightened, until the bucket body is once more drawn up to its working position and so closed. The trigger s next unlatched by means of a cord, and the bucket runs down the ladder again in readiness for another cut. The whole operation of filling, emptying and lowering the bucket ready for the next cut, is completed in thirty to forty seconds. A small independent engine is provided for raising the ladder, and regulating the depth of cut taken by the bucket. By this also the ladder is slightly lifted each time before the bucket is lowered, to allow the bucket teeth to clear the face of the cutting on their way down.

The Liege Meeting of the Institution of Mechanical Engineers.

As already announced, the summer meeting of the Institution of Mechanical Engineers will be held in Belgium, from Monday, 19th, to Saturday, June 24th. An influential reception committee has already been formed by the Society of Liége Engineers. Papers will be read dealing with some or all of the following subjects: Large Gas-engines; Electric Colliery Winding Gear Superheating in Locomotives; Manufacture of Cartridge Cases; Strength of Columns.

The following is an outline draft of the provisional programme as at present proposed, subject to revision:

Monday, June 19th: Arrival in Liége.

Tuesday, June 20th: Morning—Reading and discussion of papers. Afternoon—Visits to the International Mining Exhibition, or to Works in Liége. Evening—Banquet.

Wednesday, June 21st: Morning—Reading and discussion of papers. Afternoon—Visits to the Exhibition, or to Works in the Liége Valley.

Thursday, June 22nd: Whole day visits in the neighbourhood of Liége and Spa.

Friday, June 23rd: Morning—Rail to Brussels. After noon—Visits to Works and places of interest in Brussels. Evening—Arrive in Antwerp.

Saturday, June 24th: Visit the new docks and other places of interest in Antwerp, or neighbourhood. Members may be accompanied by ladies on the Thursday, Friday, and Saturday Excursions.

The reception committee, organised by the Liege, Association of Engineers, is as follows: Alfred Habets President; Louis Canon, Vice-President; Charles Thonet, Vice-President; Charles Beer, Jules Bolle, Alphonse Chantraine, H. Cruysmans, Professor Henri Dechamps Baron Edward de Laveleye, Edward de Roubaix, Xavier De Spirlet, Joseph Devillers, Adolphe Firket, Professor Leopold Goret, Professor Herman Hubert, Levi George Montefiore, Adolphe Greiner, Jules Magery, Charles Legrand, J. Leveque-Petit, Edouard Peltzer de Clermont, Auguste Raze, J. H. Regnier, Constant Renson, Louis Schaeffer, Florent Souheur, Carlo Spruyt, Professor Armand Stevart, Gustave Vandewyer, René D'Andrimont, Secretary.

The Royal United Service Institution—Annual Meeting.

Admiral Sir N. Bowden Smith, in moving the adoption of the report at the 74th anniversary meeting of the Royal United Service Institution, mentioned that the year's working had resulted in a debit balance of £120. Efforts would have to be made to obtain more members or else the expenses would have to be reduced. It was intended this year to celebrate the centenary of the Battle of Trafalgar by holding in the museum between May and November an exhibition of Nelson relics. Colonel Lonsdale Hale, in seconding the motion, mentioned that the total number of members at the end of the year was 5,313, which was a decrease on the previous year of 48. The journal had fully maintained its high position as a service periodical. The motion was adopted.

RECENT DEVELOPMENTS IN ELECTRIC SMELTING IN CONNECTION WITH IRON AND STEEL.

By F. W. Harbord.

Electric smelting furnaces may conveniently be divided into three main classes—(1) The induction furnaces; (2) The resistance furnace; and (3) The arc furnace—and all these three are now being employed in the metallurgy of iron and steel. Under existing conditions, the electric furnace can compete with only two methods of steel manufacture, the crucible steel furnace and the open hearth, or Siemens, furnace for the production of high-class carbon and special steels.

THE INDUCTION FURNACE.

The induction type of furnace is a large crucible in which the steel is melted by an induced current out of contact with any electrodes, completely protected from the action of any furnace gases, and practically protected from oxidation. It gives, from a metallurgical point of view, by far the nearest approach to the conditions of the crucible process, and provided the same care is taken in the selection of the raw materials, a finished product, equal in all respects to crucible steel, is obtained. The best known furnace of this type is the Kjellin furnace, which has been in operation at Gysinge, Sweden, since 1900. Figs. 2 and 3 are a plan and sectional elevation of this furnace.

The amount of energy consumed will vary with the

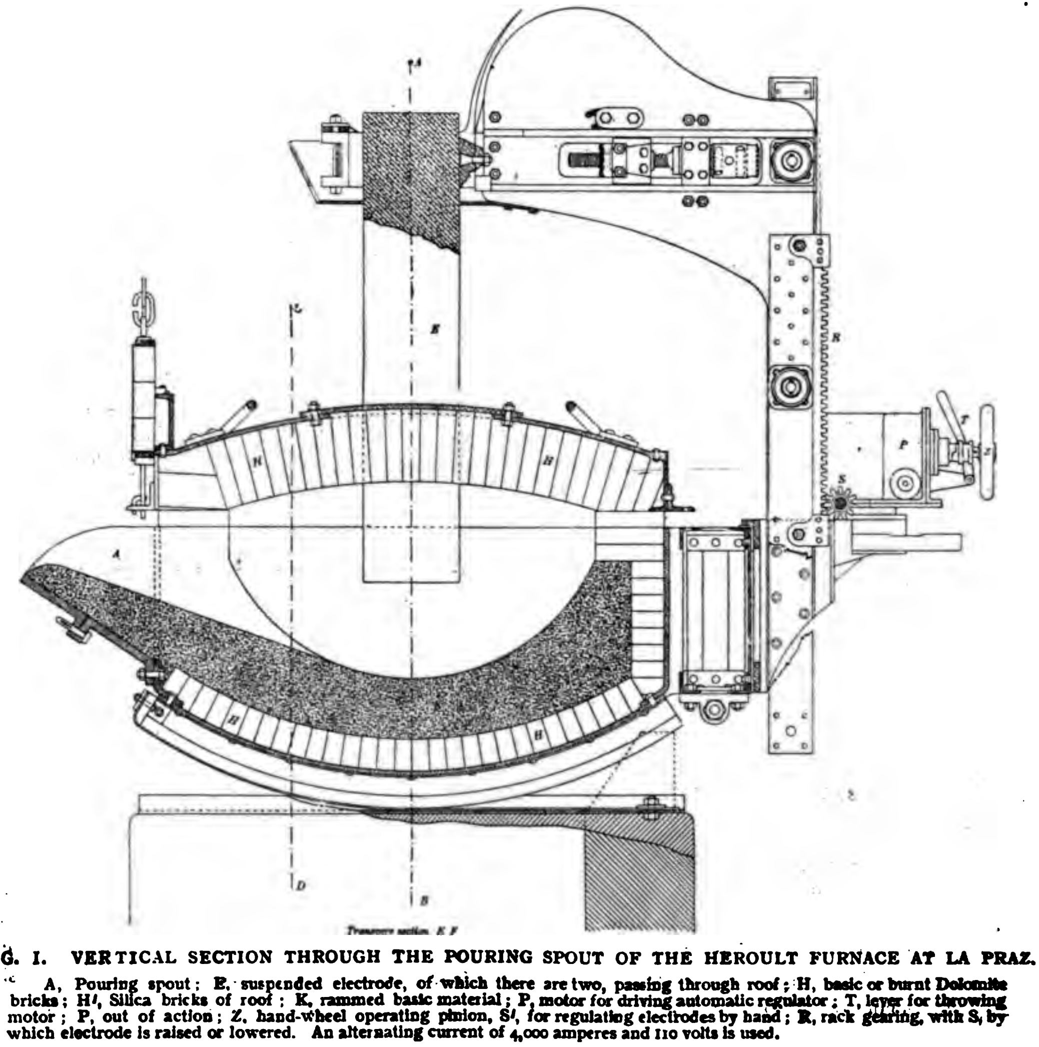


FIG. I. VERTICAL SECTION THROUGH THE POURING SPOUT OF THE HEROULT FURNACE AT LA PRAZ.

A, Pouring spout; E, suspended electrode, of which there are two, passing through roof; H, basic or burnt Dolomite bricks; H', Silica bricks of roof; K, rammed basic material; P, motor for driving automatic regulator; T, lever for throwing motor; P, out of action; Z, hand-wheel operating pinion, S', for regulating electrodes by hand; R, rack gearing, with S, by which electrode is raised or lowered. An alternating current of 4,000 amperes and 110 volts is used.

grade of steel desired, a high carbon steel requiring less than a low carbon steel. The average time for producing about one ton of steel ingots is six hours for high carbon steel and from seven to eight hours for dead soft, or nearly carbonless steel.

It should be pointed out that pig and ore can be used in the furnace, but to obtain a high-class product none but extremely pure materials can be employed, and at present Swedish materials are probably the only suitable ones which are available. This furnace in its present form can only be used for the manufacture of tools and other high-class steels, and in the majority of cases, at all events outside Sweden, it will probably pay better to use pig and scrap only, as the saving effected by ore and pig when the reduced output is considered, cannot be very great.

The following figures relating to this furnace will be found interesting:—

High Carbon Tool Steel Carbon, 1·082 per cent.

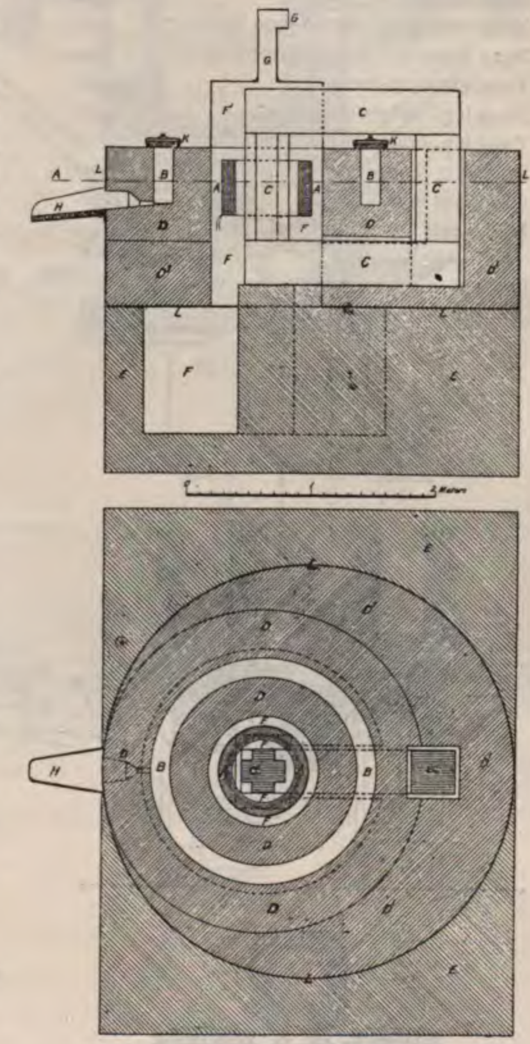
Length of run in hours	6
Mean kilovolt-amperes	217·3
Total kilovolt ampere-hours . ..	1304·
Mean kilowatts	142·8
Total kilowatt-hours	857
Mean h.p.	195
Total h.p.-hours	1165
Total h.p.-years	0·133
Output of ingots, kilos	1030
H.P.-year per ton of ingots (2,240 lb)	0·13
Cost of electric energy at 41s. 8d. per h.p.-year	5s. 5d.
The mean power-factor for the run .	0·672
The mean power-factor for 2½ hours of full-load current	0·635

Medium Carbon Steel Carbon 0·417 per cent.

Length of run in hours	6⅔
Mean kilovolt ampere	232
Total kilovolt ampere-hours; . ..	1546
Mean kilowatts	149
Total kilowatt-hours	994
Mean h.p.	203
Total h.p.-hours	1350
Total h.p.-years	0·154
Output of ingots obtained, kilos ..	955
H.P. per ton of ingots (2,240 lb.) ..	0·16
Cost of electric energy per ton of ingots at 41s. 8d. per h.p.-year ..	6s. 8d.
Mean power-factor for the run ..	0·649
Mean power-factor for 3 hours' full load	0·587

THE RESISTANCE FURNACE.

This class is best represented by the Héroult and Keller furnaces, which are both in commercial operation. Fig. 4 shows vertical section Héroult furnace which belongs to the tilting class. When high-carbon steel is required at the end of the operation, "carburite," a mixture of pure iron and carbon, is added in the furnace in such a quantity as to give the percentage of carbon required in the finished steel. At La Praz during a visit by the author, steel varying from ·079 to 1·000 per cent. was made without the slightest



Section A B

FIGS. 2 AND 3. KJELLIN FURNACE.

Vertical Section through the tap hole and Sectional Plan on AB.—AA, Primary coil of insulated copper wire wound round laminated core, C, and to which delivered alternating current of 90 ampères at 3,000 volts; BB, annular crucible or hearth, in which charge is melted and forms the secondary; CC, laminated core; D D', firebrick; D D, Silica or Magnesite brick; E E, ordinary brick foundation; F F, air space for cooling primary; F' and G, iron cylinder with pipe attached to maintain a current of air flowing round primary; H, spout from tap hole; K K, covers for annular crucible; L L, cylindrical iron casing of surface. The covers of the crucible are on a level with the working floor, and the furnace is charged by removing these and throwing the scrap and iron into the crucible, B.

difficulty, the former being a special low carbon steel used for transformers.

The following table relates to this furnace:—

Beginning of run, partial gate opening, a.m.	11·40
Full gate opening, p.m.	12·45
End of run, p.m.	7·40
Length of run, total hours	8
Mean voltage	110
Mean kilowatts, partial gate opening	215
Mean kilowatts, full gate opening	340
Total kilowatt-hours	2,580
Mean h.p., full gate opening	462
Total h.p.-hours	3,500
Total h.p.-years	0·4
Output of ingots, kgs.	2,341
H.P.-years per ton of ingots (2,240 lb.)	0.17
Cost of electric energy per ton of ingot, at 41s. 8d. per h.p.-year	7s. 1d.

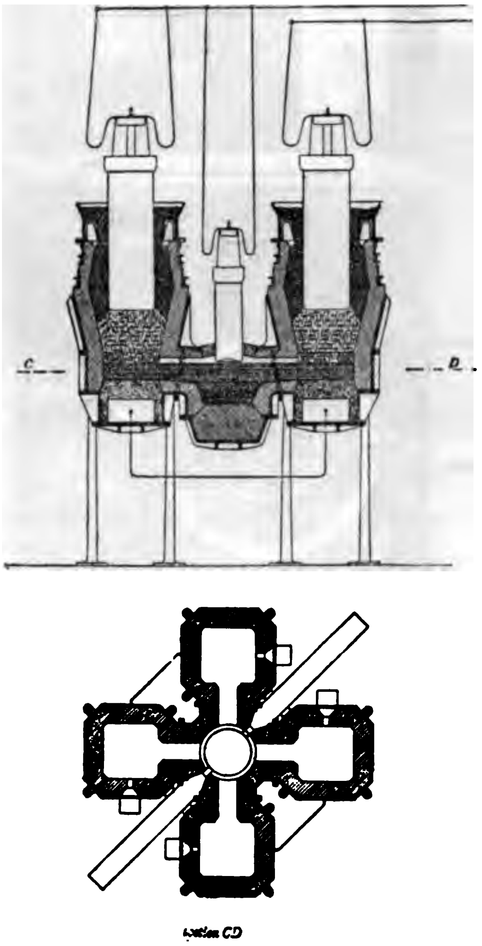


FIG. 4. THE KELLER ELECTRIC HIGH FURNACE WITH A PLURALITY OF HEARTHS.

THE KELLER STEEL PROCESS.

At Livet, at the works of Messrs. Keller, Leleux, and Co., the process of steel-making is not carried on commercially, the chief business of this firm being the manufacture of alloys. They have, however, an experimental furnace of about 35 cwt. capacity, in which they made an experimental heat. The furnace employed was identical, from a metallurgical and an electrical point of view, with the Héroult furnace, differing only in details as to tilting, etc. The electrodes passed through the roof, an alternating current was employed; common scrap was the raw material, and purification was effected by removing and renewing the slag several times. The charge made was of medium carbon, and the energy consumed was about ·120 e.h.p. years per ton of ingots made. Assuming that the cost of scrap pig, etc., in the Héroult and Kjellin was the same, the difference in the cost of production would not be more than a few shillings per ton one way or the other. The chief point, however, when one process has an advantage over the other is in the cost of raw material. The Kjellin process, to produce the highest class tool steel, is limited to the best Swedish scrap and the best Swedish pig, or pig and ore, whereas common miscellaneous scrap is the raw material used in the Héroult process. In Sweden this high class scrap can be obtained at a comparatively low figure, but in other countries Walloon scrap, if obtainable at all, which is not likely, would cost probably £12 per ton, and possibly more, and it would most likely be necessary to buy the Walloon bars at the same price as bars for cementation. On the other hand ordinary steel scrap in England can be bought from 50s. to 60s. per ton, so that in countries outside Sweden the Héroult process has a great advantage. So far as analytical, mechanical, microscopic, and workshop tests show, steels can be made either by the Kjellin, Héroult, or Keller process equal in every respect to best crucible steel.

From a commercial point of view, the manufacture of pig iron in the electric furnace is of little interest to the English electrician or metallurgist, as with our cheap supply of fuel no electric furnace can compete with a modern blast furnace. In Canada the conditions are different, so that the possibility of developing their iron ore resources by the electric furnace is a matter of great importance to the colony.

ARC FURNACES.

The Stassano is the best known of this type. The process differs from the Héroult and Keller process in so far that steel is produced direct from the ore in one furnace, instead of from pig iron or scrap. The ores used are the very purest hematites. The usual charge consists of 350 to 400 kilogrammes of pig iron, 200 to 250 kilogrammes of scrap, the necessary amount of ore being added to oxidise the impurities and sufficient lime to form a basic slag to protect the lining of the furnace, and remove the phosphorus and sulphur in the materials employed. During the last year's working the following data have been obtained: Loss on weight of materials charged, 1·5 to 2·01 as a maximum; consumption of electrodes, 5 kilogrammes per ton of steel produced; mean consumption of current, 1·2 kilowatts per kilogramme of steel produced, equal to ·186 e.h.p.-year per ton of steel; six men, an electrical mechanic, melter, and four labourers are more than sufficient for one furnace.

(*To be continued.*)

Abstract of a paper read before the Faraday Society.

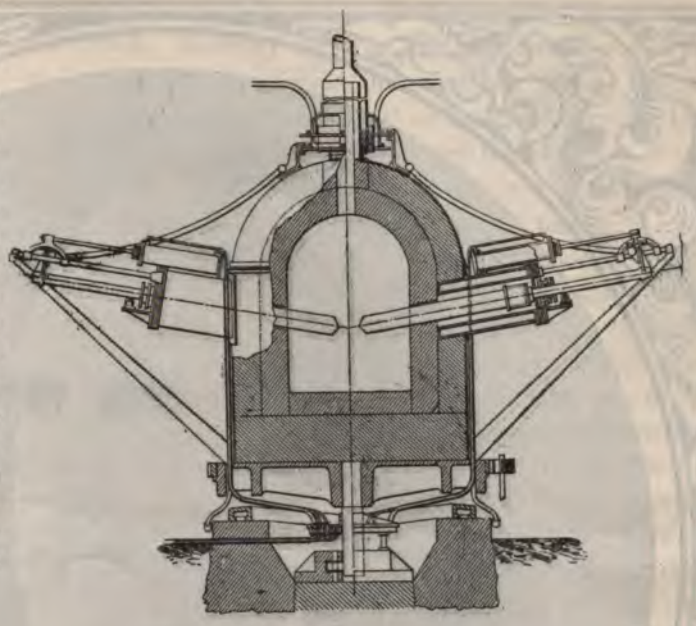


FIG.

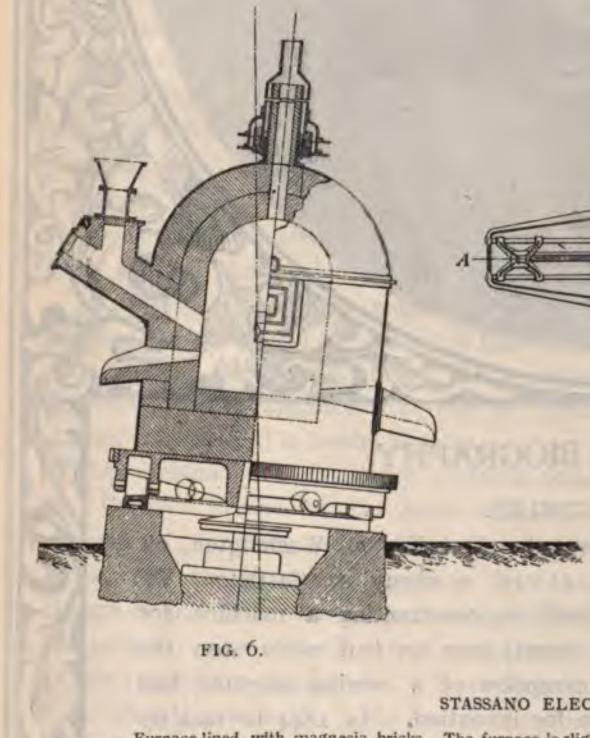


FIG. 6.

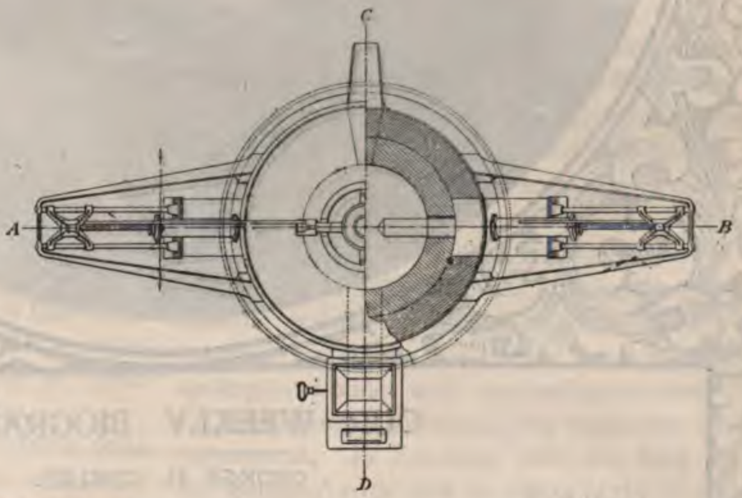
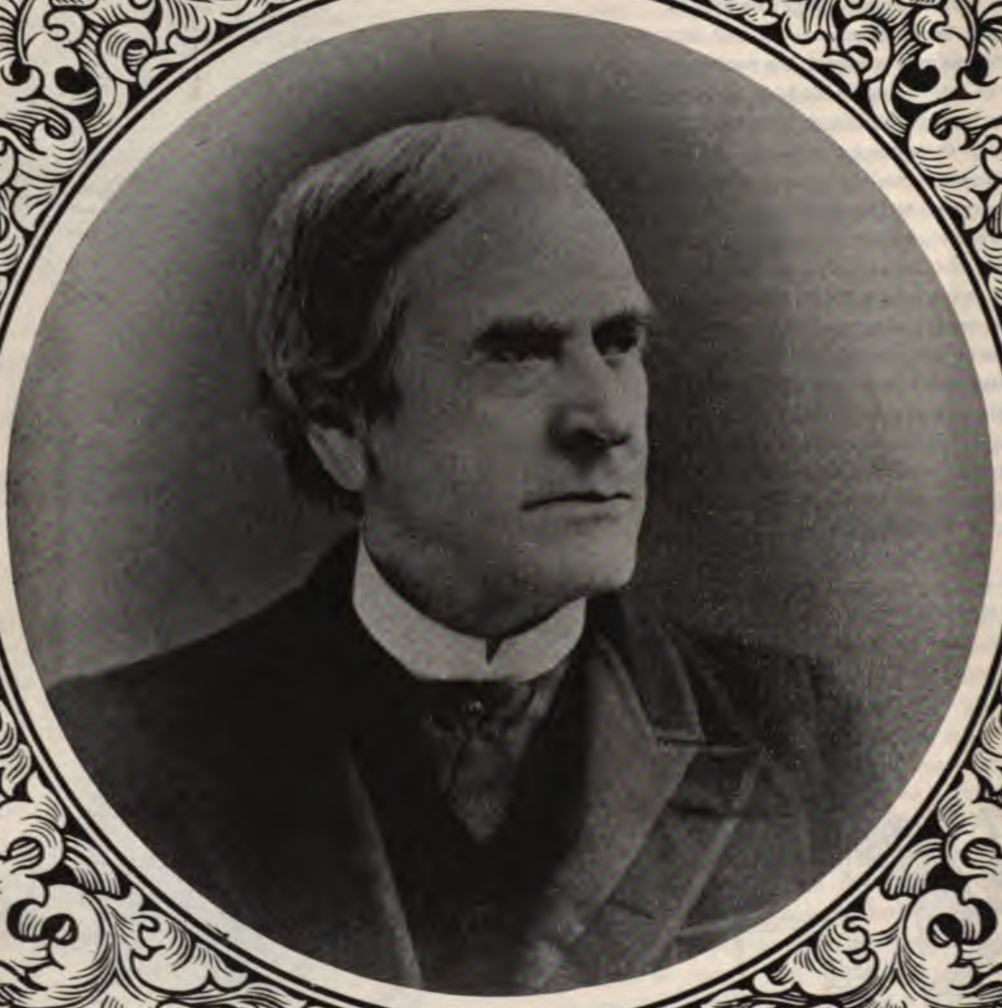


FIG. 7.

STASSANO ELECTRIC FURNACE.

Furnace-lined with magnesia bricks. The furnace is slightly inclined to the vertical, and rotated by mechanism, shown below. Volatile products are led off through tube A. BB, Electrodes; CC, hydraulic cylinders for regulating electrodes; EB water-jacket for electrodes; HH', two strong metal insulated rings (fastened to fixed tube, *b*, which does not rotate with furnace), to receive current from cables. The current is conducted to the electrodes from these rings by means of brushes, which run along the rings with the movement of the furnace; the electrodes rotate with the furnace. There is a tap hole for metal at bottom of furnace, and a slag hole at somewhat higher level. The charge is fed through a hopper and inclined shoot to deliver below the electrodes.



OUR WEEKLY BIOGRAPHY.

GEORGE H. CORLISS.

THE inventor of the Corliss engine was born at Easton, Washington, on June 2nd, 1817, and was educated at an academy in Castleton, Vt. His inventive genius first manifested itself in constructing a machine for sewing heavy leather, but up to the age of twenty-four he had never seen the inside of a machine shop, nor, with the exception of a sewing machine, had he ever exhibited any decided inclination for invention. In 1844 he took up his residence in Providence, R.I., and shortly afterwards associated himself in business with Messrs. John Barstow and Edwin J. Nightingale, under the name of Corliss, Nightingale and Company, for the manufacture of steam engines. Here it was that he began the development of his improvements in steam engines, and after about four years he completed and successfully set in operation an engine which embodied the essential features of what is known universally as the Corliss engine. This engine was of the walking beam type, having the regulator combined with the cut-off valves, and developed a capacity of 260 h.p. during the first minute of its automatic regulation of the closing moments of its induction valves. It was constructed throughout with reference to the introduction of this new feature. The cylinder was 22 in. in diameter, and had a stroke of 6 ft., and worked under 60 lb. boiler pressure.

During the same year the works of the Corliss Steam Engine Company were founded in Providence, R.I. They gave employment to a thousand men, but the productiveness of the manufactory must be estimated at a higher rate owing to its being equipped with many labour-saving devices of which Mr. Corliss was the inventor. His letters patent for improvements in steam engines were granted March 10th, 1849.

In introducing the new engine, the inventor adopted the novel plan of offering to take as his remuneration the saving of fuel for a stated period. In one instance a saving of 4,000 dollars was effected in twelve months.

The inestimable advantages accruing from Mr. Corliss's inventions met with world-wide recognition; in 1867, at the Paris Exhibition, he secured the highest competitive prize, although he had more than a hundred engineering competitors. One of the British Commissioners at this exposition—the late Mr. J. Scott Russell, in his official report, said: " The American engine of Corliss everywhere tells of wise forethought, judicious proportion, sound execution and exquisite contrivance."

In 1870 the Rumford medals of the American Academy of Arts and Sciences were awarded to Mr. Corliss, in presenting which Dr. Asa Gray remarked that no invention since the time of Watt had so enhanced the efficiency of the steam engine.

Two years later Mr. Corliss, under an act of Congress providing for the celebration of the hundredth anniversary of American independence, was appointed a Commissioner for the State of Rhode Island at the Centennial Exhibition in Philadelphia, and was elected one of the executive committee of seven who were entrusted with the preliminary work. The engine, of remarkable dimensions, furnished by Mr. Corliss for this exhibition increased his already widespread reputation; the cost of the undertaking exceeded 100,000 dollars. Eventually this engine was transferred to the town of Pullman, near Chicago, where it was utilised to supply motive power for the extensive works of the Pullman Car Company.

In 1873 the grand diploma of honour was awarded to Mr. Corliss by the Vienna Exhibition—this distinction being exceptionally noteworthy from the fact that he was not directly represented. In 1879 the Institute of France bestowed upon him the Montyon prize—which was regarded as the highest honour obtainable for mechanical achievements. Among other ingenious devices invented by this engineer is a machine for cutting the cogs of bevel-wheels, an improved boiler with condensing apparatus for marine engines, and pumping machinery for waterworks. In February, 1886, the King of the Belgians made him an officer of the Order of Leopold.

Those privileged to be intimately acquainted with Mr. George H. Corliss speak highly of the many admirable traits of his character, and a number of pleasing anecdotes are related of his singular modesty and refinement. A peculiar interest attaches to our portrait of the inventor, which was reproduced from a photograph presented by him, shortly before his death in 1888 to Mr. B. H. Thwaite, C.E.

BRIDGE LAUNCHING.

By B. J. Forrest, Mem. Can. Soc. C.E.

THE construction of a bridge may be simple but the erection of the same is governed entirely by local circumstances, and in countries where lumber for false work is scarce, and the cost of skilled labour is high, it is necessary to seek such means of handling the work in the field as will entail as small an outlay as possible for these items.

The particular work to which attention is called, is the erection of several steel bridges for the Central Bahia Railway, South America. The design for these bridges was prepared by the writer, who also had personal charge of the erection, and the bridge selected for description is one of 203 ft. length spanning a deep gorge, the base of rail being about 180 ft: above water level, and the sides of the gorge being very precipitous.

The difficulty of successfully designing the bridge was enhanced by the fact that this portion of the country is liable to severe shocks of earthquake, and suitable provision was made for the supports of the trusses, as will be described later.

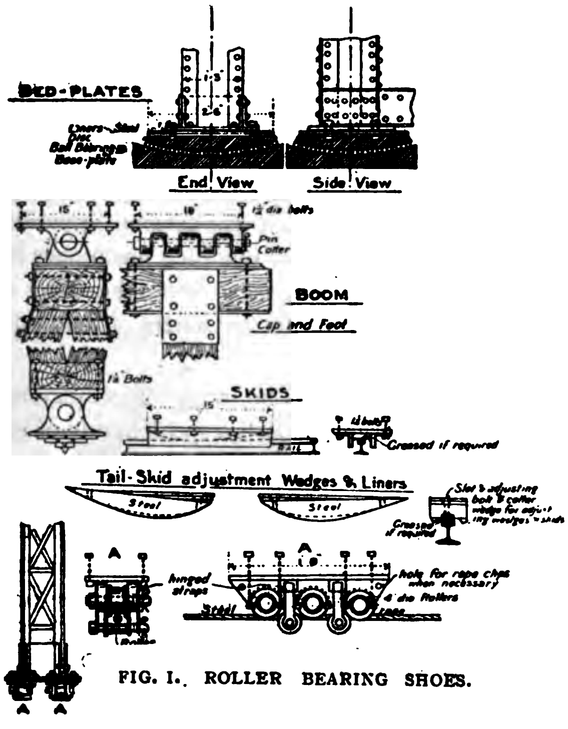


FIG. 1.. ROLLER BEARING SHOES.

Owing to the cheapness and facility of procuring cement and stone, the abutments and wing walls were built of concrete, the concrete being braced and tied together with old rails and tie bolts as indicated on drawing, since it was found that the adjacent rock was cracked and fissured for a considerable depth. The general lines of cleavage of strata ran north and south, and the direction of oscillations east and west.

METHOD OF ERECTION.

Steel suspension ropes 1⅝-in. diameter were carried across the gorge, resting on wooden roller bents at each abutment and connected to a winch at each end. Each half span was assembled, one on each side of the opening, and hauled to the beginning of opening, then the second panel of each from the centre was securely bolted to the hinged top of a temporary wooden braced boom 80 ft. long, which was pivoted on the rock face of the gorge as shown on plan. Near the centre panels of the bridge were placed rolled bearing shoes, which rested on the 1⅝-in. suspension ropes. The suspension ropes were stiffened by the use of ⅝-in. steel wire rope guys, these were used for alignment, and assisting the hauling ropes in starting, stopping, balancing, and controlling the travel of trusses. The shore ends of the trusses while being launched rested on skids, the ends being counterbalanced as much as possible during the launching. These skids rested on rails, and are shown in the illustration. Powerful screw jacks were used when these skids jammed. Hauling ropes of ¾-in. steel were attached to the trusses, the hauling being accomplished by the aid of a locomotive.

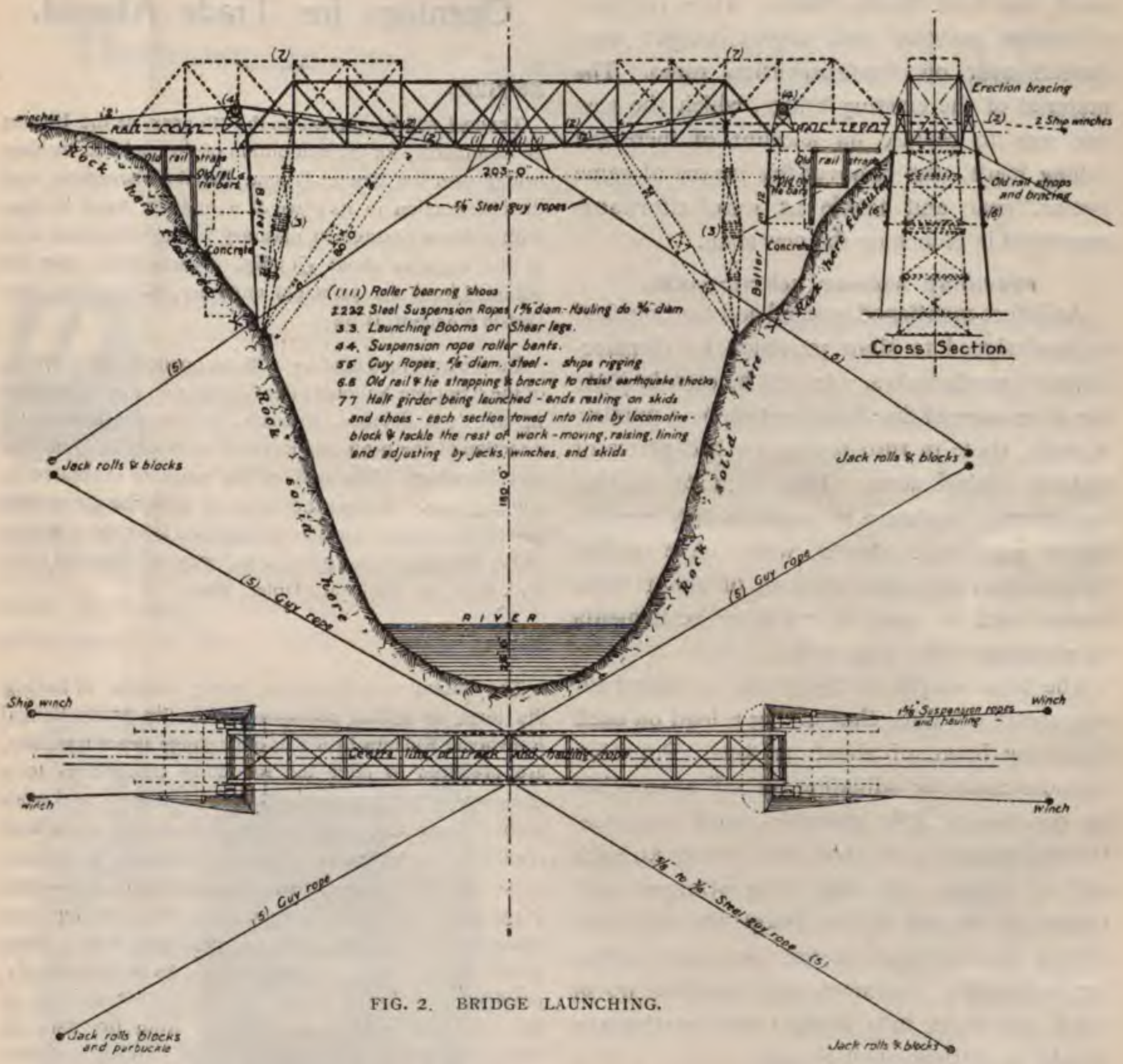

(1111) Roller bearing shoes
2222 Steel Suspension Ropes 1⅝" diam - Hauling do ¾" diam
3.3. Launching Booms or Shear legs.
4.4. Suspension rope roller bents.
55 Guy Ropes, ⅝" diam. steel - ships rigging
6.6 Old rail & tie strapping & bracing to resist earthquake shocks
77 Half girder being launched - ends resting on skids and shoes - each section towed into line by locomotive - block & tackle the rest of work - moving, raising, lining and adjusting by jacks, winches, and skids
(7)
(4)
(2)
(1)
(3)
(5)
(6)
winches
Rock here
Rock here fissured
Rock solid here
Old rail straps
Old rail & tie bars
Concrete
Batter 1 in 12
203'-0"
150'-0"
⅝" Steel guy ropes
Erection bracing
2 Ship winches
Old rail straps and bracing
Cross Section
Jack rolls & blocks
Guy rope
RIVER
Ship winch
winch
Winch
1⅝" Suspension ropes and hauling
Centre line of track and hauling rope
⅝" to ¾" Steel guy rope
Jack rolls blocks and purbuckle

FIG. 2. BRIDGE LAUNCHING.

HAULING AND CLOSING UP THE TRUSSES.

When the ends of the half spans met at the centre of the opening, the closing up and adjustment was done by means of jacks and four powerful cam jaw levers bolted to upper and lower chords of trusses, thus holding them in position while the joints were being riveted up. When this was done the centre and end cross girders and gusset plates and spandrels of upper and lower chords were placed in position, and after these the wind bracing, laterals, floor beams, and joists. The greater weight of the truss was carried on the 80-ft. boom, and the trusses were assembled at such a height that when the two halves met together, the lowering of the top ends of booms would bring the trusses to the necessary height to suit the finished rail level.

The time occupied in launching and closing up the trusses was thirty-six hours, and for fixing platform, raising clearing and closing tracks about one day. Freight traffic was suspended for three days, tracks and approaches raised, and abutments altered to suit the new bridge during this time. Passengers and baggage were conveyed across by means of a small, low level trestle bridge, while portions of bridge material and urgent freight were carried over on the suspension ropes. The material of the existing bridge, which the new one was to replace on account of increased rolling loads, was removed by means of same booms, gear and tackle as were afterwards employed in launching the new span.

PROVIDING AGAINST EARTHQUAKES.

As before mentioned, special end bearings had to be designed to allow provision for displacement by earthquakes. As will be seen in plate the shoes were of disc form, resting on a number of balls, these in turn resting on bed plates of suitable dished form. This form of bearing was found to work in a very satisfactory manner during earthquake shocks, which gave oscillatory motion at centre of span of about three inches, with no signs of cracks or settlements of abutments or wing walls.

The total weight of the bridge as launched, was about 120 tons, thus giving a load on each launching boom of about 30 tons. Provision was also made for adjusting the rail approaches by the use of four movable track entrance-trussed beams 12 in. by 18 in. fixed at each end of bridge, one end being strapped and bolted to side end of floor beam, the other end resting on cross beam bearers, skids and wedges for facilitating alignment and levelling up of track entrances into bridge after earthquake shocks or settlement of ground.

The cost of erection and launching, including labour, material and transportation of same, was about $500.00. The material used in construction of the bridge was steel, the unit stress allowed being about 13,000 lb. per square inch for both tension and compression. Maximum deflection at centre estimated at 2½ in. The main joints of trusses at the centre, as also the gusset plates were riveted, all other connections being bolted, chiefly on account of lack of skilled labour and with a view to facilitate speedy erection.

Read before the Canadian Society of Civil Engineers

Openings for Trade Abroad.

Belgium.

Tenders will be opened on the 5th prox. at the Bourse de Commerce, for the demolition of the metallic turning bridge over the Bruges-Ostend Canal at Breedene, and the construction in its place of a metallic fixed bridge, with a lower passage in masonry. The estimated cost of the work is about £13,665. Particulars may be obtained from the principal engineer, M. De Nys, Rue Coaste d'Argent, Bruges.

On the 29th inst. tenders will be opened at the offices of the "Société Nationale des Chemins de Fer Vicinaux," 14, Rue de la Science, Brussels, for the construction of a section of the projected railway between La Bouverie and Harvengt. The cost of the work is estimated at about £3,722. A deposit of £360 is required to qualify any tender, which must be posted not later than March 28th. Specifications, price 1 fr., may be obtained from M. L'Hoir, 30, Boulevard Dolez, Mons.

British India.

The Assam Administration, being desirous of having the town of Sylhet connected with the Assam-Bengal Railway at Kulaura by a 2 ft. 6 in. gauge steam tramway, are prepared to offer the following concessions to a company or a firm undertaking to construct and work such a line: the provision, free of charge, of the land required for the tramway and its stations; permission to lay the rails upon existing road embankments—with permission to widen if necessary the existing road embankments for the purpose—provided that a clear width of 6 ft. is left for road traffic. An annual subsidy, provided by Local Boards in the Sylhet district, of Rs. 1,000 per mile, to commence from the date on which the tramway is open to traffic, and to continue for a period of ten years. Reduction to 2 annas per cubic foot (converted) of the royalty due on any timber obtained from Government forests for the original construction of the line.

The length of the line would be 33 miles approximately. It is not expected that the Kusiara river would be bridged—at all events for some time to come—and it will suffice if effective arrangements are made to transport passengers and goods across this river by ferry. Similar ferry arrangements may be made on the Surma river opposite the town of Sylhet, the terminal station being situated on the south bank of this river. Applications should be addressed to the Secretary to the Chief Commissioner of Assam, Public Works Department, Shillong.

Thermometers and Pyrometers, with some of their Industrial Applications.

BY ROBERT S. WHIPPLE.

(*Continued from page* 410.)

I HAVE already referred to a recording apparatus designed by Professor Callendar. The instrument consists of a Wheatstone bridge or potentiometer in which the movement of the slider along the bridge wire is automatically effected by delicate relays worked by the current passing through the galvanometer between the bridge arms. According as the moving coil of this galvanometer is deflected in one direction or the other, a relay circuit is connected through one or other of two electro-magnets. Each of these magnets is mounted on a clock, the movement of which is prevented by a brake. When a current passes through a magnet, this brake is lifted, allowing the clockwork to revolve. The clocks are connected by differential gearing with a recording pen, which is pulled in one direction or the other, according as the brake is lifted from the corresponding clock. The bridge slider moves with the pen and tends to restore balance.

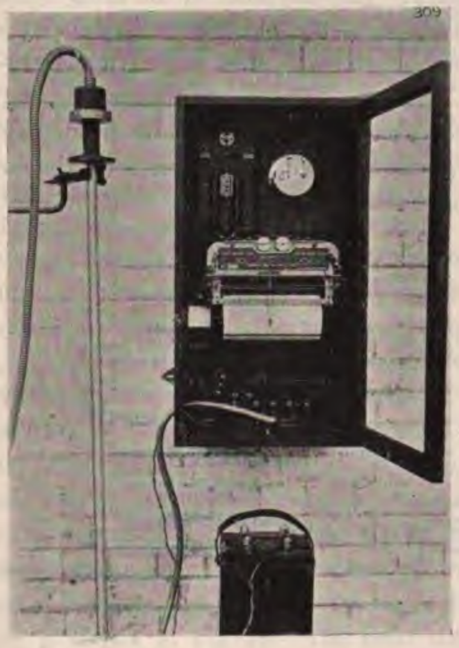


FIG. 10. CALLENDAR ELECTRIC RECORDER WITH THERMOMETER.

Fig. 10 illustrates a Callendar recorder for determining the temperatures of annealing furnaces and for general thermometric work. The two electro-magnets referred to may be seen in the top portion of the case. The thermometer protected by a porcelain tube is shown on the left-hand side of the recorder.

M. Le Chatelier refers to the recorder as the only one which records high temperatures by purely mechanical means, without the intervention of photography. This statement may not now be strictly true, yet, I believe, the Callendar recorder still provides the most satisfactory way of mechanically drawing a temperature record.

The uses to which a satisfactory recorder can be put are almost innumerable. In Fig. 11 two recalescent curves are produced; one record (A) being characteristic of a mild grade of steel (0·35 per cent. carbon), the other (B) of a finer steel. A comparison shows clearly the value of such records in discriminating between different qualities of steel.

The continuous record of the temperatures, registered by a Callendar pyrometer on the downtake of a Lancashire boiler, will be of

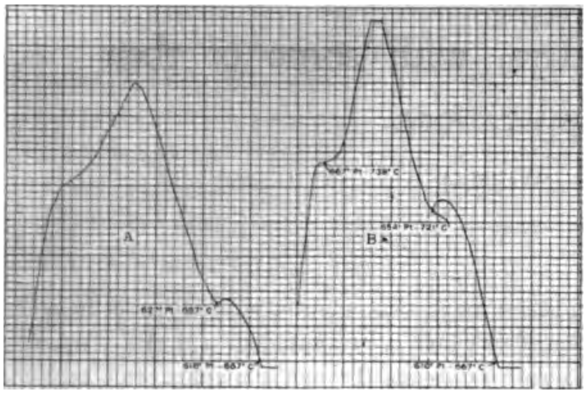


FIG. 11. RECALESCENT CURVES OBTAINED WITH CALLENDAR RECORDER.

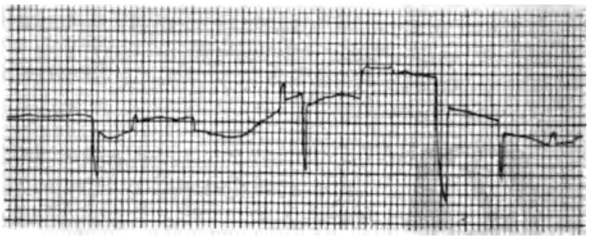


FIG. 12. TEMPERATURE-RECORD OF A HOT AIR BLAST. Record extends over 22 hours.

interest to engineers (see PAGE'S WEEKLY, p. 174. January 27th. 1905). Not less noteworthy is the record (Fig. 12) of the hot-air blast temperatures obtained in a Midland steel works. The construction and electrical connections of the thermometers employed for this purpose are shown in Fig. 13.

On every hand we hear of the "heat treatment" of steel, and anyone who has had anything to do with annealing knows the difficulty of maintaining their ovens or furnaces at a constant temperature. The fireman will go to sleep, and will swear that he was awake the whole night through, and in many cases will aver still more strongly that the correct temperature was maintained all the time, the master only learning a few days later from the tests on the material how badly the furnace has been fired. The record (Fig. 14) has been kindly supplied by a firm employing four of these recorders, and it explains hcw they have overcome the difficulty. The difference in the firing between the two men—the old experienced hand and the new man, who fires more frequently—is very striking. The thermometer (fig. 15) is provided with a heavy cast-iron head, having a large iron flange, which rests on the cover of the furnace.

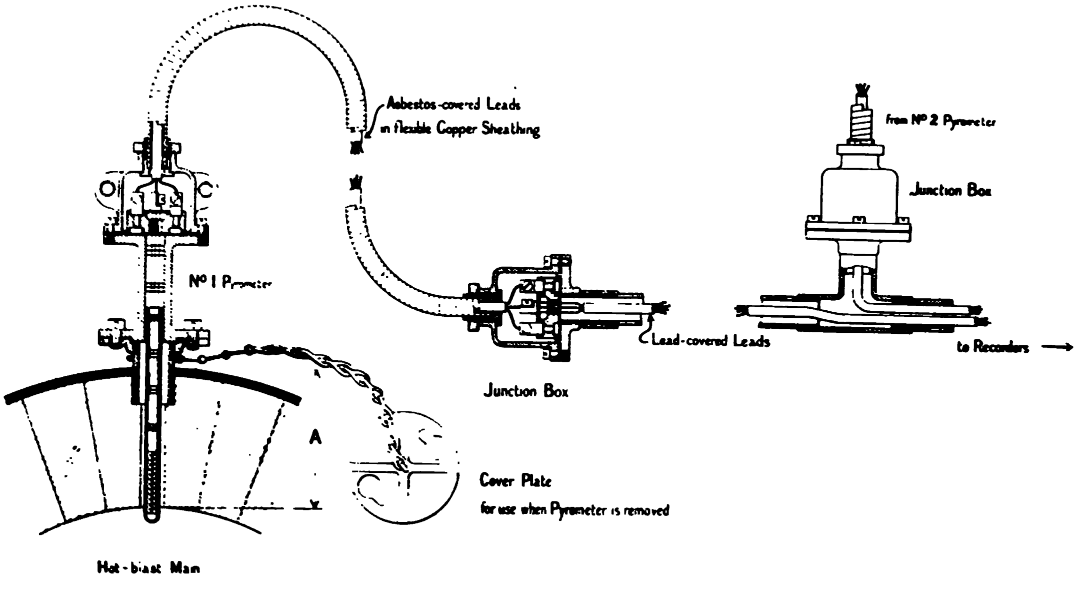


FIG. 13. ARRANGEMENT OF THERMOMETER IN HORSE-SHOE MAIN.

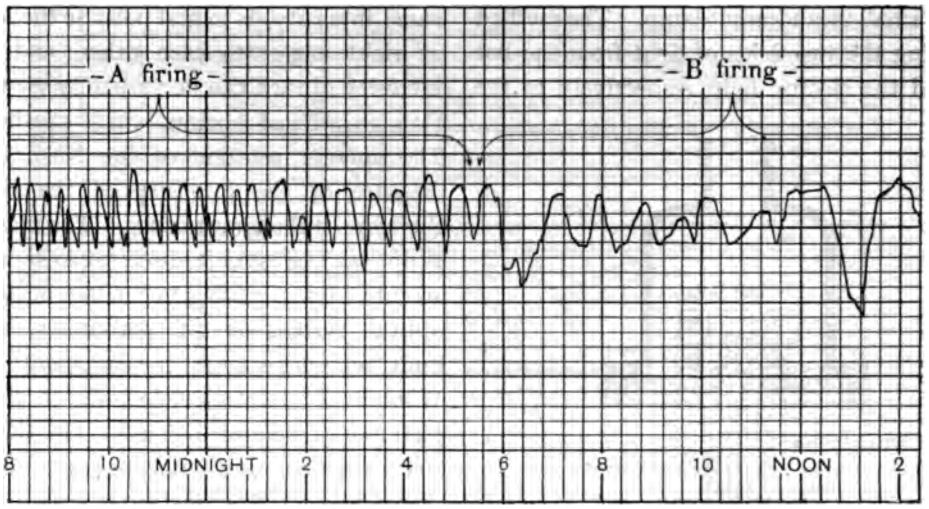


FIG. 14. ANNEALING FURNACE RECORD.

The temperature is above 700 deg. C. Each space on the vertical scale corresponds to 4 centigrade degrees.

I will now give some instances where resistance-thermometers are being used for more strictly scientific work. The first case is, perhaps, one of the more recent. Messrs. Heycock and Neville, whose work on the determination of the melting-points of metals is so well known, have recently been investigating the behaviour of the copper-tin alloys.* This important research, in which many different alloys were included, was carried out by means of these thermometers and a Callendar electric recorder.

The next example will show how extremely sensitive a resistance thermometer may be made. The illustration is taken from Callendar and Nicholson's paper on the "Law of Condensation of Steam."†

The thermometer (Fig. 16) was fixed in the piston rod of a steam engine, and its temperature read by means of a cycle contact-maker, bridge and galvanometer. A record obtained with a similar thermometer inserted in the cylinder cover is shown in Fig. 17. The most striking feature of the curve is the great superheating shown at the end of the compression.

In the latter part of 1903 Sir John Murray made a series of experiments to determine the temperature of Loch Ness. The thermometer was immersed to a depth of 201 ft., and the temperature was recorded on an instrument at a distance of 1,200 ft. from the thermometer. The thermometer was attached to a cable wound on a drum which was fixed to the deck of a boat moored in the loch, and the cable was connected to the shore cable by means of an elaborate mercury cup.

HEAT RADIATION AND OPTICAL THERMOMETERS.

Many workers have endeavoured to evolve a pyrometer that would measure the temperature of a source of heat without the necessity of inserting a "poker," as the Americans call the ordinary pyrometer.

Taking optical thermometers first, I think that on the whole the one designed by Professor Wanner is the most successful. It is based on the photometric comparison of the intensity of the light emitted by the incandescent body whose temperature is sought with the light of a standard comparison lamp. Instead of using monochromatic light, the light is spread out into a spectrum by a direct vision spectroscope (Fig. 18), and a small region in the red is used. The working standard source of light is a small incandescent lamp. The method of reducing the two fields of light from the hot body and the electric light respectively to the same intensity, is to first polarise them in planes at right angles to each other, and then the intensity of each can be varied by viewing them through a Nicol's prism, which can be rotated. The angular rotation of the Nicol is then a measure of the intensity of the light, and therefore of the temperature. The incandescent lamp can be standardised against an amyl-acetate flame. Owing to the loss of light in the optical system of the pyrometer, the lower limit of temperature measurement with the Wanner is about 900 deg. C., so that it unfortunately cannot be used for determining the hardening and annealing temperatures of many steels. The instrument is capable of considerable accuracy, it being possible to obtain temperature measurements with it to within 1 per cent.

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*Heycock and Neville Bakerian Lecture "On the Constitution of the Copper-Tin Series of Alloys," Phil. Trans. A. Vol. 202, 1903.

† Proceedings of the Institution of Civil Engineers, Vol. cxxxi., p. 23.

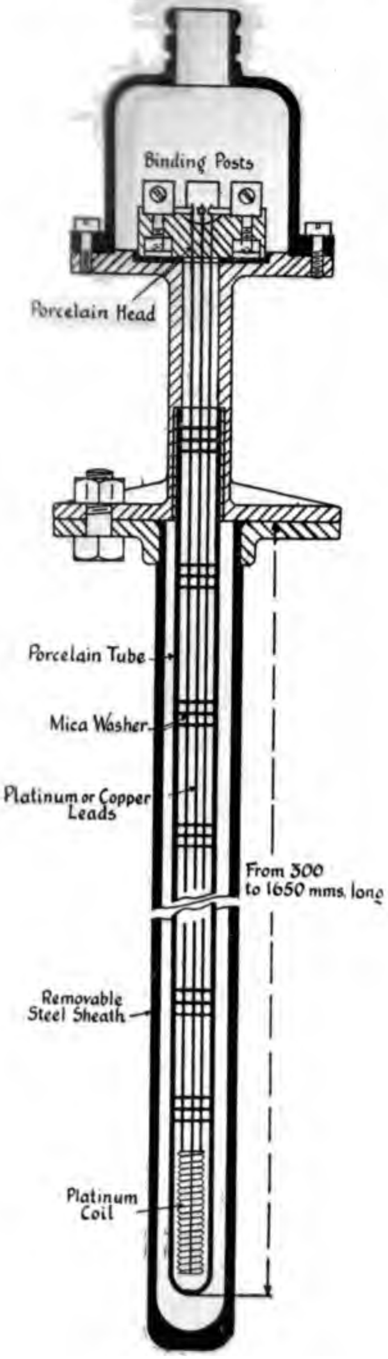

FIG. 15. CONSTRUCTION OF THERMOMETER FOR USE IN ANNEALING FURNACES.

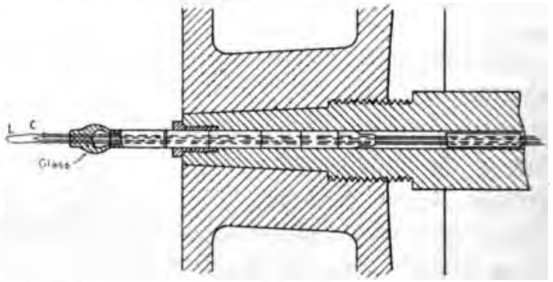

FIG. 16. THERMOMETER FOR DETERMINING THE TEMPERATURE CYCLE IN A STEAM ENGINE CYLINDER.

In Mesure and Nouel's pyrometer-telescope an attempt is made to control temperatures by taking advantage of the rotation of the plane of polarisation of light passing through a quartz plate cut perpendicular to its axis. The angle of rotation is directly proportional to the thickness of the quartz, and approximately inversely proportional to the square of the wave length.

In general the field of view will be coloured, and by turning the analyser the colour observed will change because the light, all polarised in the same plane, emerging from the first Nicol, is polarised by the quartz in various planes depending on the wave length, so that the angle between the two Nicols determines the colour that will be seen. This instrument has the

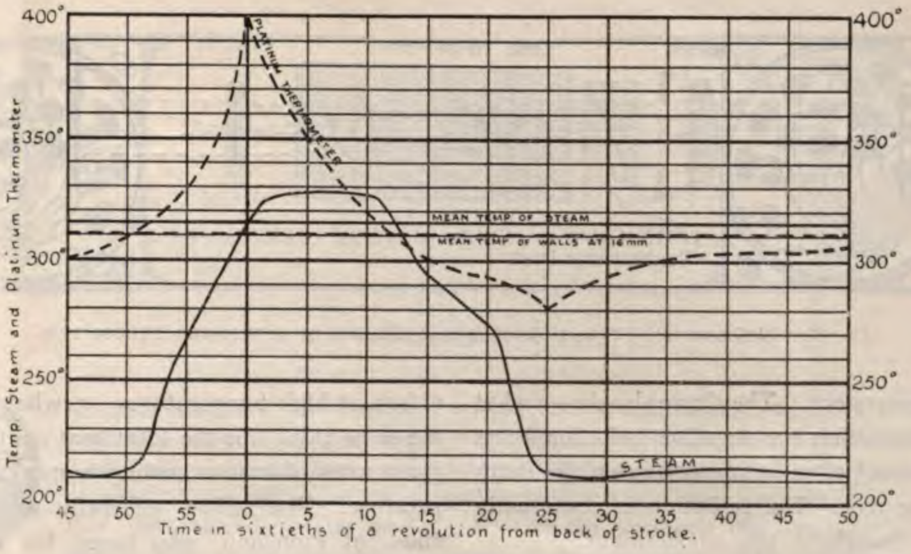

FIG. 17. RECORD OF TEMPERATURE CHANGES IN THE CYLINDER OF A STEAM ENGINE DURING A STROKE.

advantage over others that it has no auxiliary apparatus, but it lacks sensibility.

An ingenious optical pyrometer has been designed by Holborn and Kurlbaum, working at the Physikalische-Technische Reichsanstalt.* An incandescent filament is placed in the focus of the eye-piece of a telescope, and by means of an object-glass an image of the source of heat is thrown into the same plane. The current passing through the filament is regulated by means of a rheostat until the filament is no longer visible on the image of the source of heat when both sources of light will have the same intensity.

I do not know of any heat-radiation pyrometer that has been successfully applied commercially. Boys' radio-micrometer, although marvellously sensitive, is too delicate for the rough handling of everyday life. It consists of a loop of copper wire hung in a magnetic field, the two ends of the wire being connected to small plates of bismuth and antimony respectively, and a small copper plate being attached to the junctions. The heat radiation is allowed to fall upon this copper plate. A small electric current is generated, and the loop which is suspended by a delicate quartz fibre turns, carrying, with it a light mirror. Some extremely interesting work has been carried out with one of these instruments; Dr. W. E. Wilson has, for instance, concluded that, supposing the sun to be a dark body, its temperature is 6,590 deg. C.*

Professor Langley designed a radiometric apparatus under the name of a bolometer, which has since been largely developed by Professor Callendar for measuring heat radiations, more particulary solar radiations. It consists of a differential pair of flat platinum-thermometers, one blackened and the other bright, placed side by side in the same horizontal plane in a hermetically sealed glass vessel. The difference of temperature between the two, which is automatically recorded on a Callendar electric recorder, is approximately a measure of the intensity of the vertical component of the radiation to which they are exposed. It has already been shown with these instruments that the heat received by reflection from the sky under certain conditions may amount to more than 40 per cent. of the whole

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* See Sitzb. b. K. Akad. d. Wissensch. zu Berlin, xiii., June, 1901.

* Proceedings of the Royal Society, Vol. lxix., p. 320.

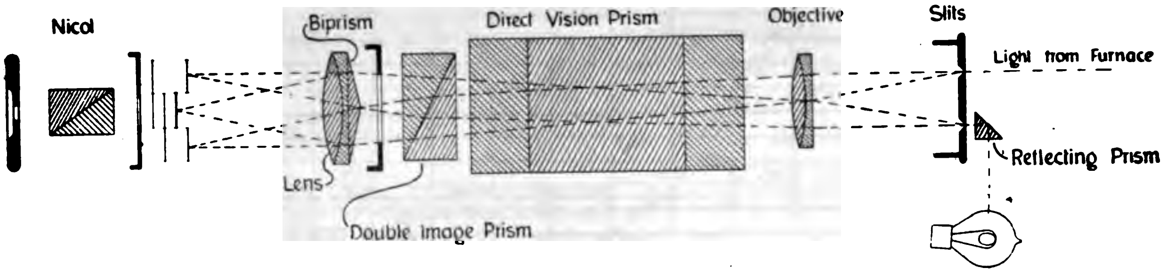

FIG. 18. DIAGRAM SHOWING OPTICAL ARRANGEMENT OF A WANNER PYROMETER.

vertical component. They have also shown what a large proportion the negative radiation bears to the amount of radiation falling on the earth during the day. The radiation is continually varying throughout the whole night.

These instruments have been successfully employed to measure boiler radiation, more especially to compare the relative efficiency of various boiler laggings.

The Siemens' water calorimeter is so well known that there is no necessity to describe it in detail. A ball of copper, iron, or platinum of known weight is exposed to the heat of a furnace, and is then transferred to a vessel containing a measured quantity of water at a known temperature. It can readily be seen that—knowing the rise in the temperature of the water, owing to the insertion of the hot body, and the specific heat of the metal ball employed—the temperature of the furnace can be deduced.

Discrepancies have long been observed between the results obtained with water calorimeters and other forms of pyrometers; but these discrepancies have now been accounted for.

Dr. Glazebrook, in an interesting paper read before the Institution of Mechanical Engineers,[*] describing the work of the National Physical Laboratory, dealt with the case of the determination of temperature with an iron ball and calorimeter.

A correspondent drew Dr. Glazebrook's attention to the fact that there were considerable discrepancies in the values given for the specific heat of iron at high temperatures, or, what comes to the same thing, for the total heat emitted by a given mass of iron in cooling from a high temperature. The values generally adopted are those of Pionchon, who based his values on the melting point of silver, taking Violle's value of 907 deg. C. This value is far too low, 962 deg. C. being now generally accepted. Research has shown that if Pionchon's values are corrected by the recent silver value, they may closely be brought into line.

FUSION THERMOMETER.

Reference must be made to the excellent work of Seger in producing a series of porcelain cones melting at various temperatures, and to the work of Mr. Henry Watkin in the same direction.[*] I would also like to draw attention to an ingenious device invented by Messrs. E. H. Griffiths and W. C. D. Whetham. An iron rod is held rigidly in a steel tube by means of an alloy melting at any given temperature. The rod is free to rotate as soon as the alloy is melted, and can be made to ring an alarm either mechanically or electrically, or to shut off gas, steam, etc. By a simple contrivance it can easily be reset for another experiment.

I feel that I have only touched on the fringe of thermometry and its many applications. The number of these applications must increase as the demand for scientific accuracy increases in all our large industries.

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[*] Proceedings of the Inst. Mech. Engineers, February, 1903, p. 83.

A paper read before the Cleveland Institution of Engineers, Middlesbrough.

[*] See "The Principle of Contraction of Clay as a Pyrometer for High Temperatures." Henry Watkin.—Proc. English Ceramic Society, 1903.

NAVAL NOTES.

WEEKLY NOTES ON NAVAL PROGRESS IN CONSTRUCTION AND ARMAMENT.

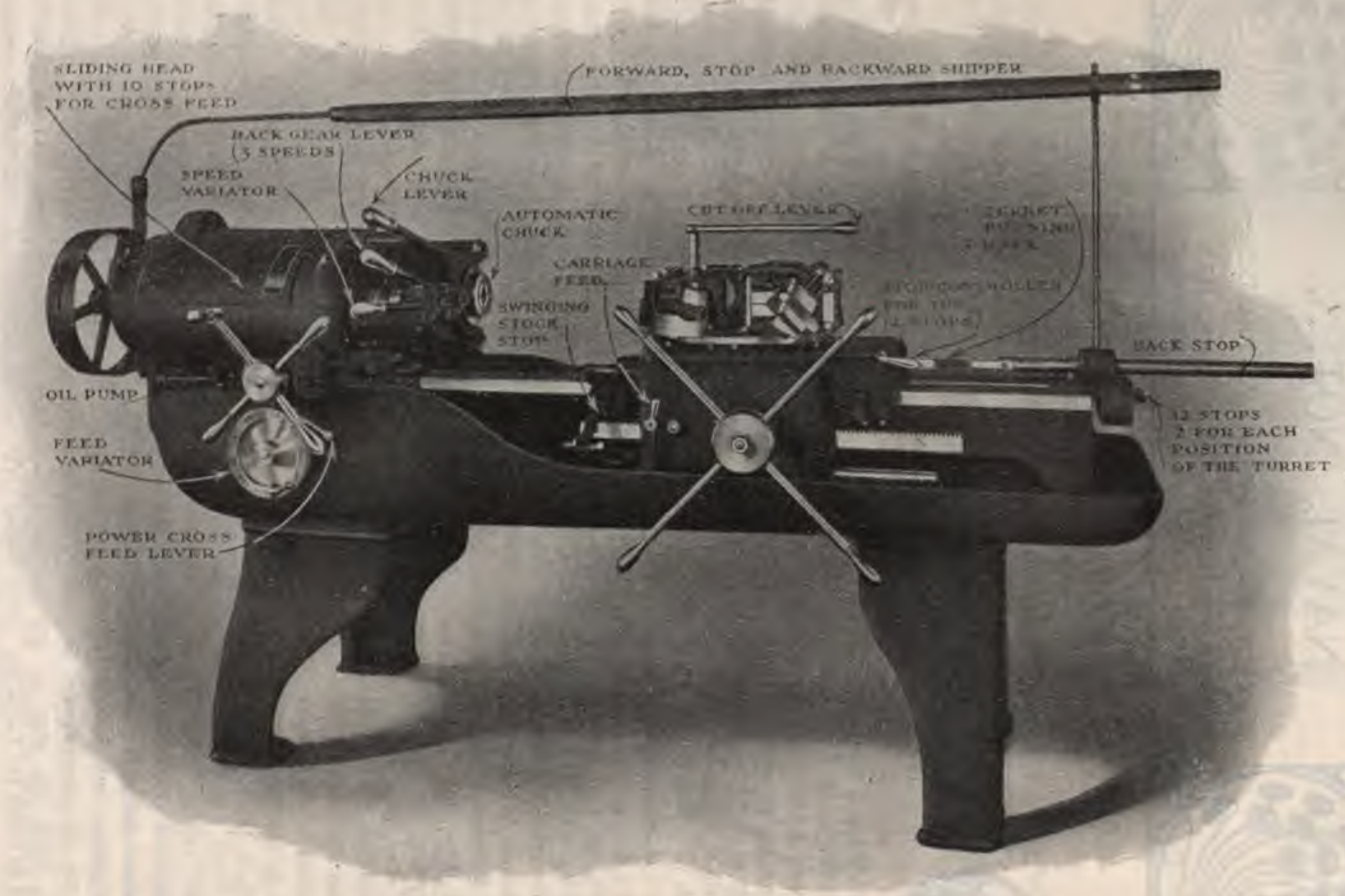
(BY OUR NAVAL CORRESPONDENT.)

THE naval estimates for 1905-06 have been received by press and public alike with a slight sigh of relief. There can be no doubt that the reduction of the total sum by three and a half millions sterling to £33,389,000 is felt to be a first step in the direction of retrenchment, to which all the leaders of public opinion combine in assuring us we must soon turn if we are to avoid national bankruptcy. But over and above the feeling of relief at the immediate prospect of a slight diminution in taxation there has been noticeable a distinct fear that retrenchment where the Navy is concerned may prove in the long run to be more costly than a continued heavy expenditure. Although Lord Selborne was able to say in his Memorandum explanatory of the estimates, that the fleet has never been in a more perfect state of repair, and though we are all convinced that in efficiency and battle-worthiness, the present condition of the British navy leaves nothing to be desired, there is always the possibility of a return to the bad old days when money for the Navy was only grudgingly given by the Treasury. We shall not always have men like Lord Walter Kerr and Sir John Fisher at the elbow of the First Lord to act as chief naval advisers to the Government.

The reduction in the total is mainly made up by the saving in votes 8 and 9, for new construction, armament and repairs. The new shipbuilding programme comprises one battleship, four armoured cruisers, six ocean going destroyers, twelve coastal destroyers, and eleven submarines. The battleship will be called the *Dreadnought*, and is to be built at Portsmouth, while the ship of the armoured cruiser class will be called the *Invincible*. With regard to the construction of this class details are not yet known, but from Lord Selborne's remark in the Memorandum that the first business of the dockyards is to keep the fleet in repair, and that accordingly the amount of new construction allotted to those dockyards should be subordinated to this main consideration, it may reasonably be assumed that all four will be built in the private yards.

It is in the destroyers that the most interesting feature of the programme is to be found. The ocean-going destroyer is something new in the world of naval architecture, and Lord Selborne has rightly explained the causes which have led the Board to the adoption of this type. In the development of the destroyer class two qualities have successively predominated, speed and sea-keeping power. Their study of the tactical and other questions involved has led the Board to the conclusion that two classes of destroyer are required for the Navy, one for the ocean work and the other for the narrow seas. They have accordingly decided to combine the qualities of speed and sea-keeping power in a special type of ocean-going destroyer which will be expensive, and of which, therefore, the numbers must be comparatively few, and to design a new type of coastal destroyer which will be comparatively cheap, and of which therefore the numbers can be larger.

There is also a reduction in the numbers of the personnel this year, only 129,000 being required as against 131,100 last year. This reduction, says Lord Selborne, is a consequence of the policy of eliminating from the Navy those ships whose fighting value is practically nil. Recruiting for the Royal Naval Reserve has been thoroughly satisfactory, and the Royal Naval Volunteer Reserve is also doing well. The number of eligible candidates for service in the navy continues to be in excess of requirements, and altogether the outlook for the Navy is thoroughly satisfactory. Lord Selborne will at least be able to congratulate himself that the last estimates he presented to Parliament showed the Navy to be in a thoroughly strong and efficient state, and that they met with approval from publicists and politicians of all shades of opinion.


SLIDING HEAD WITH 10 STOPS FOR CROSS FEED
FORWARD, STOP AND BACKWARD SHIPPER
BACK GEAR LEVER (3 SPEEDS)
SPEED VARIATOR
CHUCK LEVER
AUTOMATIC CHUCK
CUT OFF LEVER
TURRET BINDING LEVER
CARRIAGE FEED
SWINGING STOCK STOP
STOP ROLLER FOR THE 12 STOPS
BACK STOP
12 STOPS 2 FOR EACH POSITION OF THE TURRET
OIL PUMP
FEED VARIATOR
POWER CROSS FEED LEVER

LATEST TYPE 2 × 24-IN. HARTNESS FLAT TURRET LATHE WITH CROSS-FEED HEAD.

NEW FLAT TURRET LATHE WITH CROSS SLIDING HEAD.

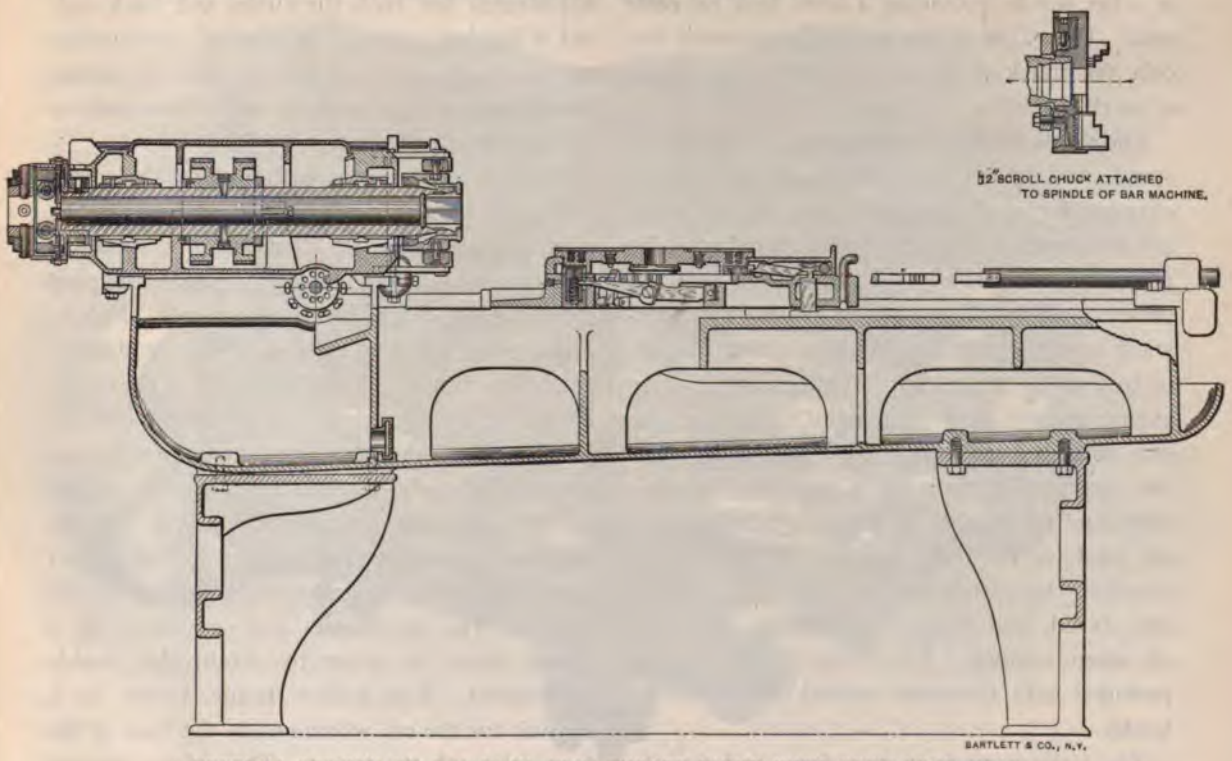
BY THE JONES AND LAMSON MACHINE COMPANY.

WE were recently afforded an opportunity of inspecting the latest model "Hartness Flat Turret Lathe" at the City premises of the Jones and Lamson Machine Company, and reproduce herewith several illustrations of this interesting machine tool development. In addition to the regular features, built into it during the last fifty years, the new lathe has an important acquisition in the shape of a cross sliding head.

The machine, as it stands to-day, represents the inventive skill of a long train of patentees, and bears witness to the cumulative effect of concentration during a long period upon one particular machine.

The entire plant of the Jones and Lamson Machine Company has for many years been devoted to the manufacture of the "Flat Turret" lathe, and its equipment of tools. They have, from time to time, produced several modified forms of the machine, the present lathe embodying only those features which have stood the test of practical work in the machine shop.

The "Flat Turret" lathe was introduced in 1891, and is, of course, familiar to the majority of our readers, but for the benefit of the few it may be well to mention the points in which the "Flat Turret" differs from other lathes. In the first place the headstock is mounted on guideways running across the machine, instead of being affixed to the bed. It contains all the necessary gears and clutches for producing all the changes of speed. The carriage carries a flat circular plate-shaped tool-holder from which the lathe



VERTICAL SECTION OF 2 × 24-IN. FLAT TURRET LATHE WITH CROSS-FEED HEAD.

takes its name. The frame or bed is a single casting formed with guideways which run lengthwise for the carriage and crosswise for the headstock. The lower part of the bed casting serves as a receptacle for chips and oil.

The new machine has an ideal scheme of speed regulation. After making trial of several combinations and positions in order to get the best form of self-contained speed variator, it was found advantageous to arrange all the shafting and gearing in a horizontal plane, ample lubrication being obtained by the complete submergence in oil of the lower half of all the running parts. This determined the adoption of the shallow pan-shaped frame for the headstock, which includes all the clutches and bearings. The natural form of bed for holding the headstock made it easy to give the latter a cross travel. The sliding headstock is securely gibbed to the guideways, thus giving the spindle a cross feed relative to the turret, or, in other words, providing a cross feed for each tool. The value of this feature is apparent not only for chuck work, but for many other kinds of work.

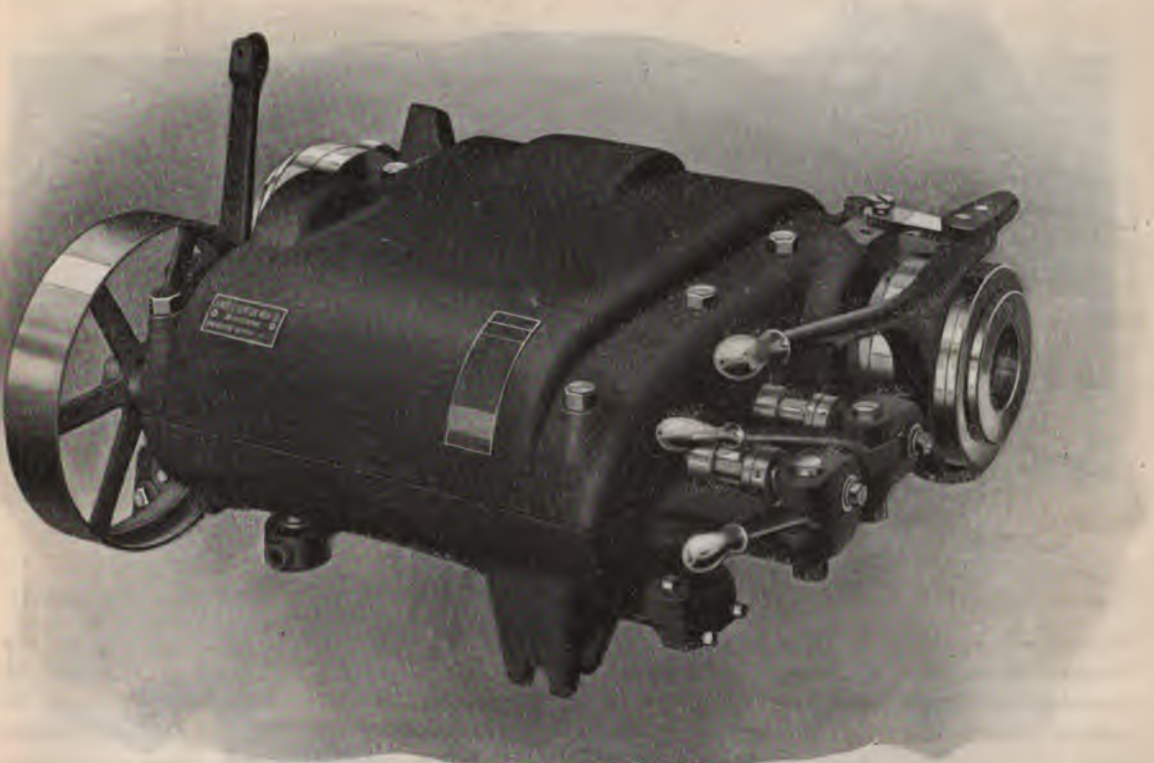
The single drive receives power at a constant speed, and in one direction, and all of the changes for variation and direction of speed are obtained by clutches and gears between the power receiving shaft and the spindle. As the pulley receiving the power is driven at a constant speed, it may be belted to a countershaft or to a motor at the head of the machine. An even tension of the belt is maintained by means of a compensating base. High speed steels tax the running bearings of a machine to their limit, and in order to meet this, bronze bearings are used for the driving shafts. They are enclosed in the chamber formed by the headstock and its lid, and receive a continual shower of oil when running. The cross sliding head is provided with ten stops carried in a revolving holder.

The lathe is made in two sizes, and may be furnished with an equipment of tools for either bar work or chuck work, or a double equipment for both. The smaller machine, shown on page 524 is known as the 2 by 24, and when equipped with the automatic die outfit of tools it turns out the same work as the original 2 by 24, excepting that the hole through the spindle is now made 2⅜ in. instead of 2⅛ in. The general arrangement of the lathe will be understood by a reference to page 524, the various features being clearly indicated on the half-tone block.

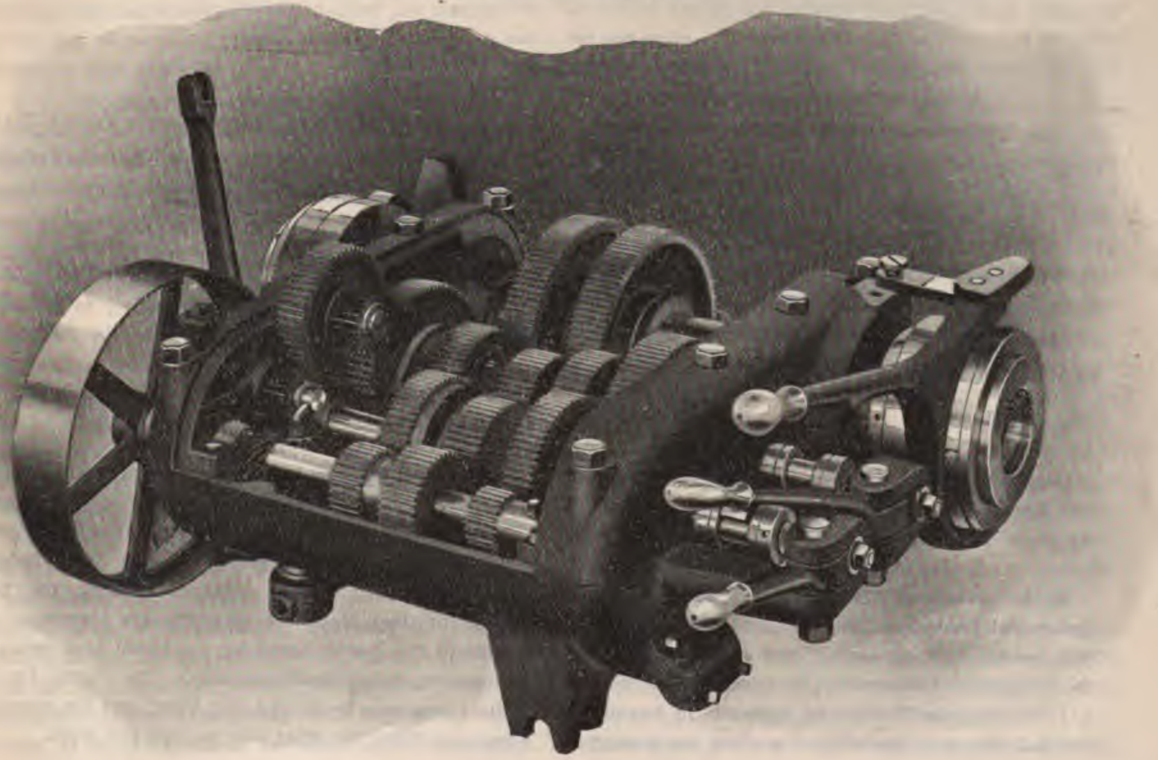
The working range of the lathe is astonishing, the outfit turning all diameters up to 2¼ in., and all lengths up to 24 in., and cutting United States standards screws from ⅜ in. to 1¼ in. inclusive, by sixteenths, or Whitworth, Metric or V standard, as desired.

The turner illustrated on page 528 is the result of the natural development of the original turner around which the "Flat Turret" lathe was designed. It is provided with a double adjustment for both the cutter and back rest, but it has lost none of its original convenience and simplicity, and may now be used for turning one diameter only without any inconvenience from extra adjustment.

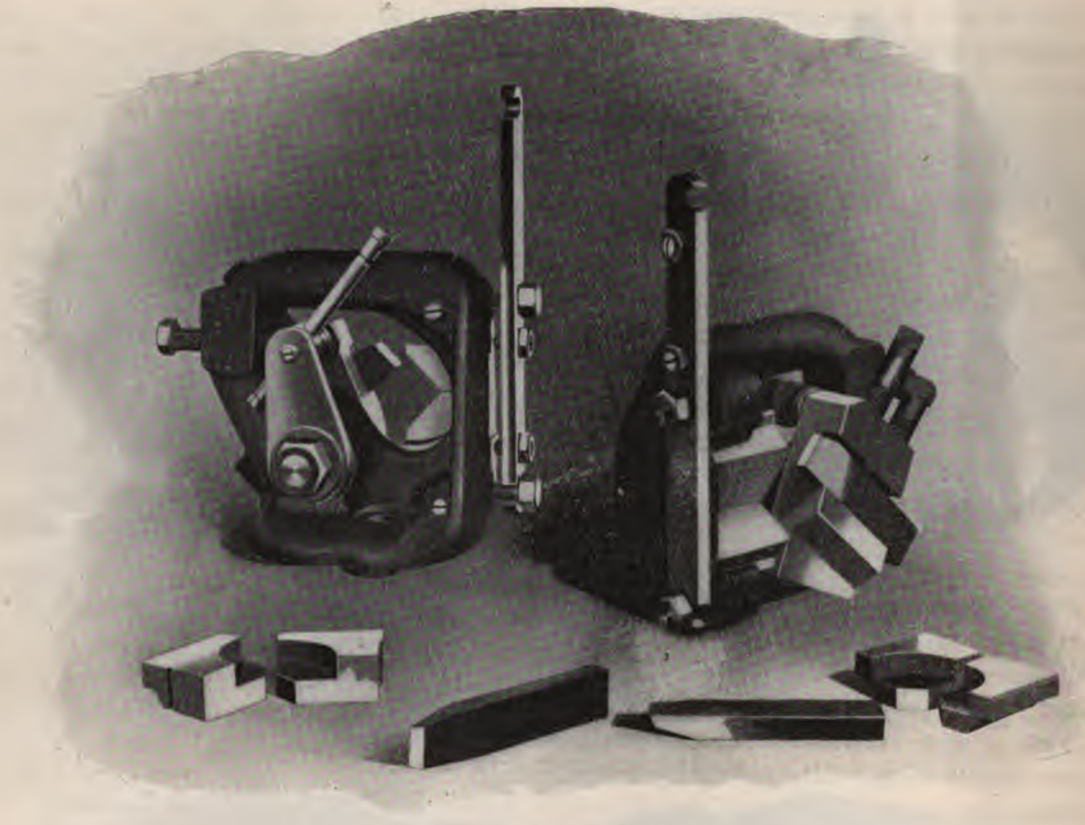
The quick means for withdrawing the cutter and back rest for opening the turner when passing over a larger diameter are retained. The cutter is of rough 1-in. by ½-in. high-speed steel. It is held in the pivoted tool block of forged steel, which in turn is accurately fitted to the hollow frame. The adjustment of the cutter is affected by two screws, arranged side by side. These screws take bearing against cams on cam shaft, which is controlled by a handle similar to that used in a machinist bench vise. These cams are diametrically opposite, so that either may be brought into action by a half-turn of the handle. The back rests are controlled by a double latch, in order to obtain the double adjustment. The hollow frame serves as a conduit for the oil, which enters the base of the frame through the turret. The oblong opening



SLIDING HEADSTOCK WITH COVER.



THE HEADSTOCK WITHOUT COVER.
This view shows sliding headstock with roller feed and automatic chuck on spindle.



A GROUP OF TURNERS AND CUTTERS.

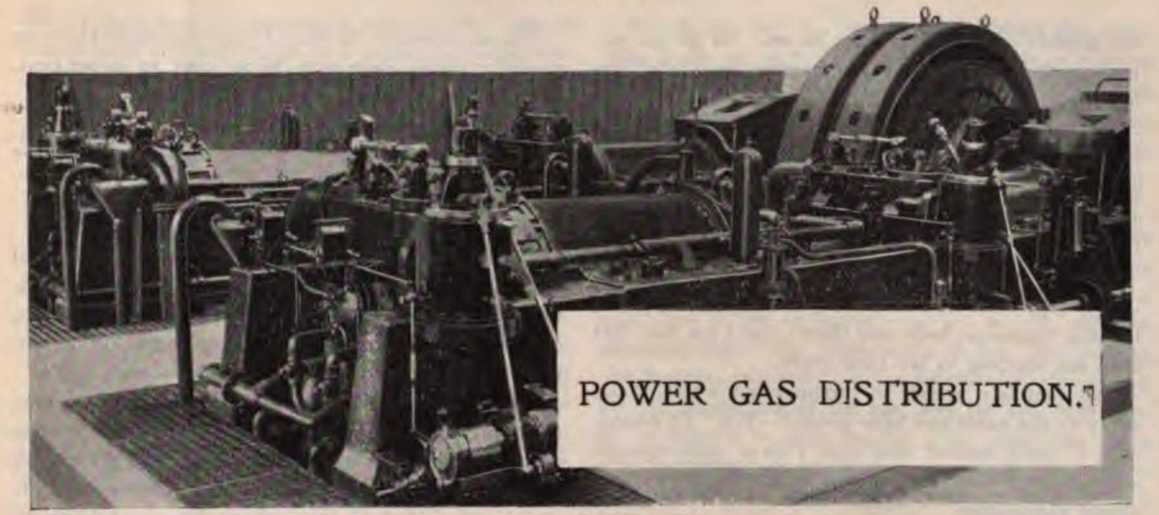
in the frame over the cutting tool delivers a large, slowly-moving stream of oil directly on the cutting edge.

Thanks to the features outlined above, the firm claim to have produced a machine which is always in absolute readiness to make any piece of work of any shape quickly and accurately, and to turn out work in lots of from two or three to a thousand pieces with turret lathe speed, and the accuracy of a well-handled engine lathe. It is claimed *inter alia* that the "Hartness Flat Turret Lathe" is the only turret lathe having this cross-feed head; that it is the only single-drive turret lathe, and is the only one in which all speeds and feeds are instantly obtainable.

Messrs. Royce, Ltd., of Manchester, have appointed Mr. J. G. Barber as their representative for the Birmingham district.

We are informed that the directors of the Vulcan Boiler and Insurance Company, Ltd., 67, King Street, Manchester, are arranging with the authorities of the Victoria University, Manchester, to establish a Fellowship for study and research in engineering, but full details of the scheme are not yet arranged.

Messages can now be sent to Cunard mail steamers at any stage in their voyage across the Atlantic. During the first three or four days after the vessels leave Liverpool the messages are sent from Poldhu, Cornwall, direct to the steamer. During the next three or four days the messages are forwarded by cable to the North American Continent and repeated thence to the approaching ship. The charge for the direct messages is 2s. 0½d. per word, and for messages repeated from the other side 3s. 0½d per word.



POWER GAS DISTRIBUTION.

TWIN-COUPLED DUPLEX-CYLINDER SINGLE-ACTING 1,200-B.H.P. NUERNBERG GAS ENGINE.

Evidence *a propos* of the Dudley Port Power Gas Installation described in our last issue.

IN his evidence before the Royal Commission on Coal Supplies, Professor Burstall remarked that the use of large gas engines for the generation of electricity is now only in its infancy, but it may be taken as quite certain that within a few years we shall see engines of from 4,000 to 5,000 h.p. capable of running with such regularity as to allow the alternators to be run in parallel. The economy of the large gas engine is undoubted.

COULD LONDON BE SUPPLIED?

Asked if he considered there was any limit, or to say what would be the maximum distance which gas could be economicaly transmitted so as to reach a centre of population such as he described, the Professor said: I think about 80 miles in one transmission would be the limit, that is to say, 80 miles with only one set of pumping. If you choose to take two or three sets of pumping, I think probably about 300 miles is the limit.

That would be large enough for any distance in England?—Yes; it is perfectly feasible to supply London with the whole of the coal that it requires from the Derbyshire and Staffordshire fields.

You mean all the gas?—In the form of gas.

Would you now make clear to us what you mean by the pumping? Taking first your figure of 80 miles, I understood you to say that that could be done with one pumping?—That could be done with one pumping, that is to say, the gas would be led from the producer into an air compressor where the pressure would be raised from that of atmosphere to the required pressure, which, at 80 miles, would be about 45 lb. per square inch gauge pressure. That I call the pumping or the compressing, which requires, of course, a certain amount of energy in order to pump the gas up to the compressor, the whole of that energy being expended in the friction in the main.

Professor Burstall further said he had taken 48 in. as being about the largest that would be desirable for one main. It was stated that each stage of 80 miles involved, roughly speaking, a loss of about 13 per cent. of the whole for compression pumping.

THE QUESTION OF LEAKAGE.

Questioned as to possible losses by leakage Professor Burstall said this was a matter upon which they had only the Paris air mains to guide them. There the loss is about ·4 per cent. per mile on the ring main of 20 miles in length, but the pressure there is 100 lb. per square inch above atmosphere, and the network is not constructed in the streets in a very good manner. He thought there was reason to suppose that the loss by leakage would be about one tenth of 1 per cent. per mile; that is the maximum amount.

That is assuming that the joints are made tight?—That is assuming a mechanically-made joint.

Is there any difficulty with regard to the joint itself, do you think?—None whatever; I have seen joints that have kept very high pressure indeed on them for unlimited times without showing any leak whatever.

Passing over some further questions in the course of which Professor Burstall said he thought we should very shortly see gas engines in this country of 4,000 or 5,000 h.p., we come to the following:—

Then you give us an interesting table showing the mechanical efficiency, and so on. So far as you know, is there any movement in the direction of what you have been giving us in this interesting evidence?—Yes, the South Staffordshire Mond Gas Company have Parliamentary powers to distribute producer gas over a certain section of South Staffordshire, and a great deal of that plant is made, and the pipes are being actually laid in the roads.

In what part of South Staffordshire are they at work laying pipes?—I could not say exactly what parts, because I have not been over there; but I am told that they are starting to lay their pipes.

And that is a system of producer gas which would apply in the cases you have given?—Yes. Of course, it is a much smaller area than I have contemplated and therefore they are only using a pressure of 7 lb. above atmosphere.

Of course that lessens the cost of transmission?—Oh, quite so.

Is this gas at work anywhere much except at Mond's place, or the industry with which he is connected?—It is mainly being used in chemical works, because of the fact that there they want to reduce their cost to a minimum. There is a large gas plant at Allbright and Wilson's making phosphorus; there is a large producer gas plant at the Solvay Company in America. These are all about 12,000 to 15,000 h.p. There is a large plant at the Castner Kellner.

THE SMOKE NUISANCE.

As I understand, one great point which you make is that by this manufacture of gas you will get rid of smoke?—That is so.

And there will be no smoke whatever?—It is impossible to get any smoke.

But if you were to keep the chimney going for the raising of the coal you would still have the smoke?—But I should not; I should do all the raising of the coal by means of gas engines driving three-phase plant. I should have no steam plants at all.

Then you look forward to the day when these gas producers will be at the pit mouth, and when there will be no smoke, and when power will be transmitted as required throughout manufacturing towns, and for lighting in all parts?—That is so.

Have you made any comparison with regard to the proportion of economy in money that there would be by this process as against coal to-day in its raw state?—I have not made any calculations of that, because that is such a large question that it would mean a very serious amount of work to do; but in general terms it may be stated that there is a very considerable saving indeed over our existing state of affairs, taking everything into account.

You say towards the end of your statement that you would probably save from 30 per cent. to 50 per cent. of the total coal consumed in the country?—Yes.

That is in quantity, I suppose?—In quantity.

Or you would make the same coal do double the work?—Yes.

ANOTHER VIEW.

For a moment we are tempted to feel quite cheerful as to the prospects of a fogless London; but let us see what Sir George Livesey, M.Inst.C.E., and chairman of the South Metropolitan Gas Company, has to say upon the question of gas transmission:—

Do you think the suggestion is a practicable one, that we could be supplied in London from the districts where the coal pits are?—No; not at all; I do not think that is at all practicable. That has been thought of a number of times in past years, but it has always been dismissed as impracticable. The cost of sending the gas would be greater than the cost of bringing the coal.

You mean the cost of pumping it?—Yes.

Is that due to the friction in the pipes?—Yes; and the capacity of the pipes which you would want. Of course, if it were to be pumped, it would have to be pumped under very heavy pressure; otherwise the pipes would require to be such an enormous size.

We quote the following interesting excerpt from the evidence of Mr. Henry McLaren:—

So that, if the gas engine be improved and made more reliable, so as to take the place of steam engines to a considerable extent, we might really hope for a very considerable saving in the actual consumption of coal?—Yes, I think so. I am a steam-engine man, but I cannot shut my eyes to the fact that the gas engine is to be the engine of the future. There are considerable difficulties with the larger engines. The smaller engines can run without jacketing their pistons with water; their radiation is larger and they have jackets round the cylinders. But there are considerable difficulties to overcome before you get to the very large gas engine, *e.g.*, owing to their having to put water into the piston, which is a thing that is flying backwards and forwards, and therefore very awkward to deal with; but I have no doubt that the men who are engaged in the manufacture of the gas engine to-day will bring it to perfection. Thermally considered it is far and away ahead of the steam engine; but for reversing purposes and things like that, the steam engine cannot be beaten.

That is to say for handiness?—For handiness and comfort in working. Another great point is the nuisance of gas engines in towns. We have two gas engines at the Yorkshire College, which have been the bane of my life; I have had the silencing of them to do. One is a very large one, and we are in a residential neighbourhood, and it is a most difficult thing to deal with; it took years to make it so that our neighbours could live alongside it.

What gas were you burning there?—Town gas at 2s. 3d. per 1,000 cubic feet.

I thought this remedy of yours would have effectually done that?—What do you refer to, may I ask?

"Scrapping" them.—It would have done so; I advocated that, but I could not get the House Committee to go with me.

When gas engines are isolated, say for a small application of power, a small gas engine is infinitely more economical than taking steam to any distance, is it not?—Certainly. I have much more faith in the distribution of gas in bulk and using it in gas engines than I have in the distribution of power by electricity from central stations.

Do you think the distribution costs less?—I think with Mond gas it will cost less—that there will be less loss in the main.

And less condensation?—Yes.

The following is from the evidence of Sir Alfred Hickman:—

Staffordshire is one of the districts where the Mond gas is being put into operation, is it not?—It is not yet in operation.

You mean it is not yet in operation as regards the public companies supplying it?—Exactly.

But it is in operation, I understand, in the Midlands as regards Mond plant, or a plant for the production of the producer gas has been supplied to particular factories?—I believe it is to a small extent.

Do you yourself look forward to power being conveyed in future by means of gas pipes; because, if so, that will modify the view with regard to large wagons?—I do not think that it will ever make much difference in the coal traffic.

Why?—Because the coal will have to be carried to some central station after all.

A central station in the sense that if you have half a dozen collieries within half a dozen miles, you will have some plant in the middle of them: do you mean in that sense?—No, the plant would be placed somewhere in the middle of where the gas would be likely to be used.

But that is not the view that has been presented to us; the view that has been presented to us is that the coal should be converted into gas practically in the neighbourhood of the colliery and brought to London by means of pipes?—That is a scheme I had not heard of.

But is that not the scheme of the Mond Gas Company?—So far as I am acquainted with it, a gas-producing manufactory is being erected in a central position in what they call the Black Country, that is practically between Birmingham and Wolverhampton, and it is proposed to distribute the gas throughout the district for manufacturing purposes.

Would the manufactory of the gas be far away from the coal pit?—Not very far, but I do not think it would be a less distance than the average that the coal has to be at present carried to the different manufactories. The manufactories are clustered in the district, and this is a central place in the district for the production of the gas, and the coal will have to be carried to that central place about the same distance that it is at present being carried to the different manufactories to which the gas will be conveyed. I do not know whether I make myself clear.

Yes, I think I understand you, but I am surprised to hear what you say. I will put this proposition: Coal is to be carried ten miles to the place where the gas is to be made, and the distance the coal is to be carried to that point is to be as great from the colliery as it is from the colliery to the factory?—Yes.

But is still to be carried from the place where the gas is manufactured to the factory, which you say would be a distance equally as great?—The gas manufactory is in the centre of the district and of the manufactories using the gas, which surround it at distances from nothing or a few hundred yards up to about six miles. At present the coals are conveyed to these manufactories all the way round.

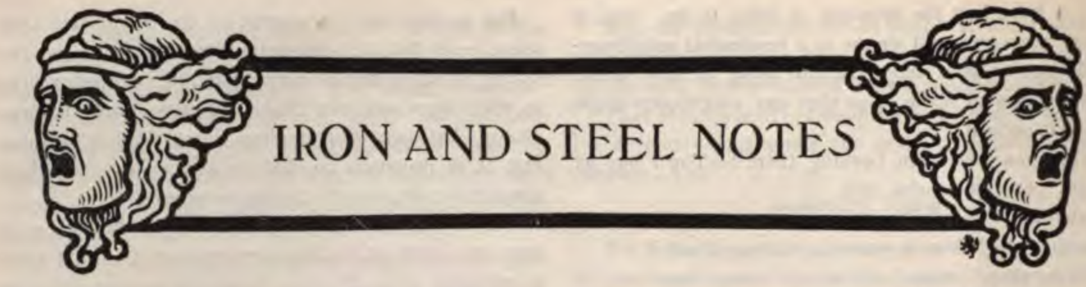
A distance of six miles?—A distance of six miles on an average.

And it would be still a distance of six miles from the place where the gas is to be made?—Precisely; they are varying distances, but, on the whole, I do not think much would be saved in that way; there might be a little, possibly. There would be this advantage, that supposing the scheme were carried out on such a scale as to supersede the use of coal at all at the works, which is not very likely, there would be an advantage of a larger quantity going all to one spot instead of being distributed to various places.

And the large wagons then would be more practicable?—Yes.

And larger train loads?—Yes.

Has this plan been applied to any of the large trade manufacturing concerns in your district?—Not yet. It is being applied. I am myself using gas from blast furnaces for driving engines; I am putting up 4,000 h.p. to use the gas for driving engines instead of boilers and steam engines.



IRON AND STEEL NOTES

THE paper by Mr. J. E. Stead, F.R.S., on "Science in the Iron Foundry," concluded in the last number, may be said to have been an elaborate plea for accurate analyses. Some very interesting remarks bearing on this point are made in a paper which was read a few days ago by Mr. E. Adamson, of Sheffield, at a meeting of the Manchester Association of Engineers.

Perhaps, says Mr. Adamson, the reason why the Americans can work so well on analyses, is that there is probably not an ironfoundry of any consequence which has not a metallurgist or metallurgical engineer whose duty it is to attend solely to mixings, and accept or reject pig irons as they are delivered. Where one foundry is not large enough to employ one man exclusively, several group together and pay a retaining fee, and as this practice is increasing in favour, it seemingly must be found to pay. This metallurgist is not necessarily a chemist, and a chemist is not always a metallurgist, but when the two can be combined in one man, so much the better.

Mr. H. Souther, of the American Foundrymen's Association, is quoted on this point. He says: A little money spent systematically on the services of a metallurgical engineer (not a chemist) pure and simple, may save far greater sums. It is very much in the nature of an insurance against loss. Conditions may seem so favourable for months at a time possibly; materials may be received of such uniform and satisfactory quality that money spent for expert services will appear to be wasted and therefore the plan discontinued, and then all of a sudden things go wrong.

A good chemist may be able to determine the amount of the various elements in the iron or fuels to the third decimal to the minimum of chemical error. He may be quick to do a large number of determinations per day, but of what use are results without practical interpretation and application? A chemist may become the best kind of metallurgist, but only in one way—personal contact with metallurgical operations in every detail and in several branches. A good share of common-sense is a most necessary and valuable adjunct.

A metallurgist need not be a chemist, but he must know how to use a chemist and the results obtained by a chemist, which is an absolute necessity to a metallurgist. Assuming an engineer of metallurgical matters is employed, then to get the greatest benefit the work must be systematised. Regular tests of product must be made often—if changes are made in mixtures, frequently—or at least in the event of the slightest irregularity of product. They need not be so often if changes are infrequent, or in case of a smooth running, but should never be less often than weekly.

As to the difference between a pure chemist and a metallurgist, Mr. Adamson remarks that the former after analysing for the elements upon which it is customary to report, and finding these within the prescribed limits, would then analyse for some other elements, not usually expected to be present, and finding these, or perhaps one, present, even in very small quantity, would be liable to blame this as the cause of failure. The metallurgist, however, should know the possible effect of such element, and if the fracture of the iron or steel did not give a sufficient indication, would probably call in the aid of the microscope. Then, too, there is what is generally known as the "missing" carbon in steel—this might mislead a chemist, but it would not a metallurgist.

These remarks, continues Mr. Adamson, may be strong, but there are cases on record of British firms, engaging a young chemist who has just finished a term at College, and they expect him to be a thoroughly competent metallurgist as well as a chemist. This is scarcely the opinion of Mr. Souther, but it is not, perhaps, fully realised in all works that metallurgy and chemistry are two totally different things, and both are only sometimes covered by one hat.

An example is given of the methods of Amerian merchants. A large firm, one of the largest American iron and steel merchants, will take a contract for instance from a pipe foundry to supply a given analyses in the pipe for a given test for a fixed price per ton of pig iron, and they will supply a mixture of various brands, giving the buyer the proportions of each to use along with scrap. The traveller, who is also an expert metallurgist, is well paid, his salary reaching as much as $5,000 per annum. This is a step in advance of the English merchant's practice, says Mr. Adamson, and perhaps our merchants might copy.

Turning again to Mr. Stead's paper it will be noted that he fully recognises the difficulty of a metallurgist and a chemist wearing one and the same "hat." Mr. Stead has probably reached the solution of this difficulty when he says that the founder must take the material available. Having selected a man, his real training must begin on entering the foundry laboratory, and whether or not he develops into a useful metallurgist must largely depend upon his ability and capacity for gaining knowledge.

A document worthy of more than passing attention is the report on the iron and steel exhibits at the St. Louis Exhibition by Mr. E. Seymour Bell, British commercial agent in the United States. This report has just been presented to Parlimaent. It is gratifying to read that from an instructive point of view that the portion of the British exhibit representing the iron and steel industries was undoubtedly the best in the foreign section. The samples were small and well arranged. It was very comprehensive, and the information supplied concerning each sample was, as a rule, satisfactory. Mr. Bell remarks that there is certainly more satisfaction and instruction to be gained by examining, for example, a dozen small samples of iron ore than by looking at one large piece occupying the same or greater space. The cases in the British section were light and not crowded together, and there was no difficulty in seeing everything clearly. The iron ore samples were representative of the different localities from which they were taken, and the approximate percentage of iron contained in them was given. Though the samples of semi-manufactured products were not numerous, they clearly indicated the great variety of manufactures of iron and steel of the United Kingdom and included cases of samples of pig iron, bars, etc., as well as a case of small but interesting samples of materials employed in the manufacture of special steels.

LAUNCHES.

Messrs. William Gray and Co., Ltd., have launched at West Hartlepool the large steel screw steamer, *Turkistan*, which they have built for Messrs. Frank C. Strick and Co., Ltd., of Swansea and London. The vessel will take the highest class in Lloyd's and is of the following dimensions: Length overall, 384 ft. 6 in.; breadth, 50 ft.; and depth, 30 ft. She is a handsomely modelled vessel of the three deck-type, with poop, long bridge and forecastle, having very tasteful cabin accommodation in houses on the bridge deck for passengers, captain and officers, and is fitted throughout with electric light.

The vessel has a cellular double bottom and after peak tank for water ballast, and in addition there is a deep tank or hold compartment fitted for water ballast abaft the engine room, giving a total capacity for water ballast of about 2,000 tons. The decks are of steel and iron and all weather decks except in wells are sheathed with teak. The outfit, including steam windlass, steam steering gear, ten steam winches with return exhaust to winch condenser, and marine type donkey boiler is of the most approved description, including Porter's patent derrick sockets for dealing with heavy lifts. The machinery is made by the Central Marine Engine Works of the builders, being of the triple expansion type, with cylinders 28 in., 46 in., and 77 in., and a piston stroke of 48 in. She is fitted with Weir's feed pump and heater and two large steel multitubular boilers working by Howden's forced draft at a pressure of 180 lb. per square inch. The vessel and machinery have been constructed under the superintendence of Mr. Archibald Walker.

Messrs. Furness, Withy, and Co., Ltd., Hartlepool, have launched the fine steel screw steamer *Haverstoe*, which has been built to the order of Messrs. Bennetts and Co., Grimsby. The vessel is over 350 ft. in length with a cubic capacity of about 339,936 ft. She is built of Siemens-Martin steel throughout and takes Lloyd's highest class. All the most modern appliances will be fitted. A cellular double bottom is fitted fore and aft for water ballast, the after peak being also available as a tank. Iron grain divisions and wood shifting boards are fitted throughout. Accommodation for the master and officers will be fitted up on the bridge deck and the crew in the forecastle. Messrs. Richardsons, Westgarth and Co., Ltd., will supply triple expansion engines having cylinders 24 in., 39 in., 66 in., by 45 in. stroke, with two single-ended boilers 16 ft. by 10 ft. 6 in. long, with 180 lb. pressure.

INLAND NAVIGABLE WATERWAYS.

BEFORE the Society of Engineers on Monday last, Mr. Benjamin H. Thwaite read a paper on "The Transport Possibilities of our Inland Navigable Waterways." The following is an abstract:—

Engineering science is not without its obligation to the old canal constructors, who provided much of the experience in excavation, embankment formation, puddle work, retaining wall and bridge construction, warehouse building and sluice making, which was available for the early railway builders.

The neglect of the canal system, as the result of the railway boom and Government indifference to the fate of the canals, followed by the depreciation of canal stocks, permitted the railway companies to initiate a policy of absorption as a preliminary to the destruction or suppression of their traffic competitor as far as practicable. No one can blame the railway companies; the Government alone was to blame. To-day the nemesis of the action of that day's Government is found in the supremacy of the railway companies over Parliament. Very different has been the policy of the Governments of France and Germany. Our commercial and industrial competitors have largely extended their canal systems, which have generally been maintained in a high state of working efficiency.

The ratio of canal absorption by the railways is about one-third of the total length. The number of canal navigations that have been under railway control is fifty-four, with a length of 1,205 miles. The canal navigations outside railway control are eighty-nine in number, with a length of 2,609 miles, many miles of which are now temporarily useless through neglect. The main arguments advanced by the railway companies to support their policy of canal absorption were to the effect that such a control would enable them to promote economy, and to reduce their freight rates. As a matter of fact, the removal of the waterway rival has enabled the railway companies to advance rather than reduce their rates.

The map which the author has prepared, page 504, shows very clearly the extent of breaking up by the railway policy of canal control. Very little through-canal traffic can be maintained without the goodwill and consent of the railway companies. That this policy of suppression of our inland navigable waterways has only been too effective is a painful fact. Hundreds of miles of our canals are little better than elongated ditches of mud or stagnant water, and it is now impossible to trace many miles of canals for which Acts were obtained, and which were eventually made. How different is the case abroad. The United States of America has, according to one authority, 20,000 miles of inland navigable waterways; Germany has 16,000 miles, and France has length of navigable waterways as follows: 6,000 miles. The Almanack Hachette gives the Canals, 4,930 kilometres; navigable rivers, 8,325 kilometres. Germany has 2,530 kilometres of canals.

TRANSFORMATION OF CANALS INTO RAILWAYS.

The suggestion has recently been repeated that our canals should be converted into railways. Although for short straight lengths this has been done in a few instances, it is obvious that, as canal routes follow level contours with lock methods of elevation as distinct from the gradients of railways, their transformation would be very difficult if not impracticable. It would be better, if such a retrograde step is ever found to be worthy of application, to transform the canals into motor or carways, as has been suggested by the author. Such a transformation might be applied to feeder canals, to permit motor wagons to act as distributors and collectors for canal services, for which they would be very efficient. The argument that railway companies would lower their rates to make canal competition impossible is a *reductio ad absurdum.*

Fig. 3 shows at a glance that canal transport costs are below possible railway competition in England. Besides if such a canal revivification by the State brought down railway rates, traders and the public generally would consider the national expenditure on the canal revivification to be well justified, even by its effect in securing a railway freight reduction.

The Worcester Chamber of Commerce has formulated a scheme for a canal trust, that shall control the operations and improve the character of the following group of canals: The Thames and Severn; the Upper and Lower Avon; the Wilts and Berks; the Stratford-on-Avon; the Stourbridge and Birmingham; the Somerset, Worcestershire and Birmingham; the Shropshire, Gloucester, Berkeley and Stroud.

ADVANTAGES OF A CANAL SYSTEM.

The capital cost of a canal is a mere fraction of that of a railway. The cost of making English canals is fairly represented by the figures of £3,500 per mile Against this the cost of railways per mile of formation looks seriously formidable if represented by the figure

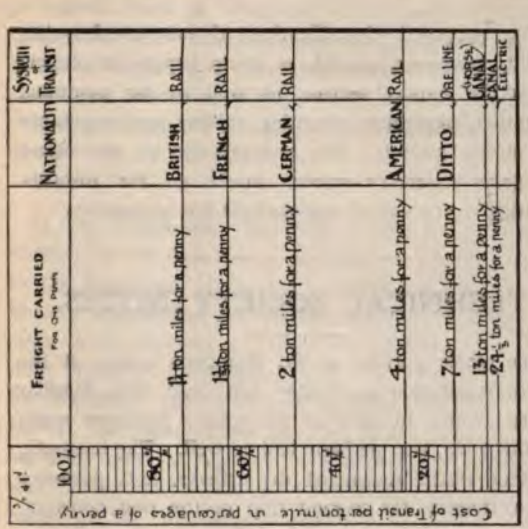


FIG. 3. COMPARATIVE COSTS OF TRANSPORT.

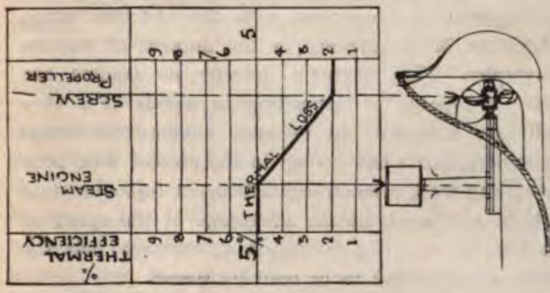


FIG. 2. THERMAL EFFICIENCY.

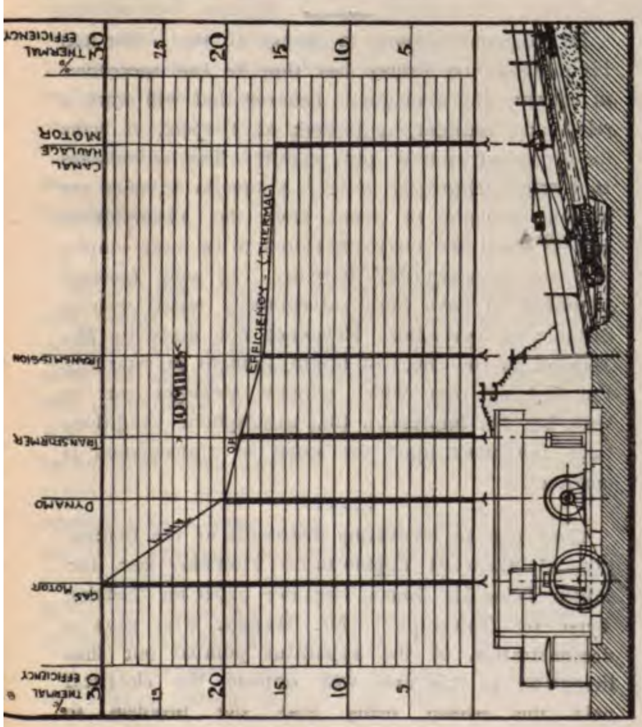


FIG. 1.

of £46,000 per mile. The capital amount actually paid up per mile of English and Welsh canals is said to equal £8,472. The capital invested in British railways is said to be equal to £52,370 per mile. The cost of transport on canals by horse haulage and electric methods is shown graphically by figs. 1, 2, and 3. The figures representing horse canal traction costs were supplied by the expert of a large and independent canal company. The items making up the cost of electric transport have been carefully determined.

Figs. 1 and 2 show the comparison between the thermal expenditure of a canal electrification system and that associated with a steam tug. In this latter system the energy absorbed in overcoming the skin resistance of the tug is neglected. A thermal efficiency of 5 per cent. is assumed for the engine with a screw propeller efficiency of 40 per cent.

The author has dealt with the causes of the decadence, and he has suggested that the State should confiscate the canals or absorb them by compulsory purchase at a fair valuation. It is obvious that unless this is done it is useless to discuss very closely any mechanical or other methods of reviving the general usefulness of our canals.

PROPOSED METHOD OF WORKING.

Circumstances put out of court all systems of electrification that involve the employment of screw propellers with aerial methods of electrification or otherwise, and electrically - propelled locomotives travelling on the tow-path that rely on their own weight for the necessary adhesion qualifications.

The method that has been admitted by the practical canal experts of this country (and for which the author and Mr. George Cawley, M.E., are jointly responsible), consists in the employment of an electric horse, so the motor is called, that travels on light superposed steel rails carried by vertical standards erected at intervals along the extreme boundary of the canal tow-path. The wheels of this electric horse grip on the steel rail providing the adhesion necessary to secure the haulage of the boat, the grip of the motor being directly proportionate to the tension on the tow-rope. One rail permits the electric horse to draw its boat in one direction, and another, super-elevated, permits its electric horse and without fear of entanglement of the two ropes, to draw its burden in the contrary direction.

This system therefore provides a practical electrical canal haulage solution which is suitable to the peculiar conditions of English canals, and which permits the highest practical efficiency to be obtained. Elaborate tests made in a German canal with an electric haulage system, apparently a modification by Ganz of the Thwaite-Cawley system, gave a 68 per cent. efficiency of haulage effort. The locomotive has a haulage capacity of 37·5 h.p. and is capable of hauling barges of 600 tons burden. The average working cost per kilo mile is stated to be equal to 0·05 penny with current at 1·4 penny per kilowatt. The cost of a kilowatt would in England be less than this.

Of course the electrical energy would, for trunk canals, be transmitted at high pressure and transformed to lower pressures for distribution. Gas power generating stations would be located every 20 miles in the length of the canal. The tow-paths would provide the way-leaves for laying the high-pressure conductors, which could serve for a general supply at cheap rates to all the areas (already unattached) through which the canal traverses. The locks, gates and sluices could be electrically actuated, and electric capstans would provide the necessary elasticity to the haulage system. The warehousing, hoisting and conveying machinery could also be electrically actuated, and there would be the obvious advantages of a cheap and abundant supply of electric energy for canal, dock and warehouse electric illumination and other services.

Electric energy is being successfully applied to actuate both canal, lock and sluice gates on Canadian canals, and swing cross-canal bridges are also being electrically rotated. The canals are being electrically illuminated; in one of them, the Soulanges Canal, alternate arc lights of 2000 c. p. are placed high over the canal tow-path, at distances of 160 yards, allowing night operations to be carried on.

ESTIMATED COST OF REORGANISATION.

The following is an estimate of the cost of nationalising, perfecting, and electrifying our canal system. Assuming that 3,500 miles of the canal system of Great Britain were purchasable at two-thirds of their original cost of construction, say £2,350 per mile of length, then the capital required would be £8,225,000. Allowing £500 per mile for the cost of standardising the locks, and £2,000 per mile for the electrification of the canals, then the total amount required would be £16,975,000. Allowing the balance to make up 20 millions to be set aside for working capital, it should secure for the State a splendid transport property. Seeing that over 60 millions sterling have been expended in tramway systems in this country, and that over 300 millions sterling have been absorbed in municipal work, the Government could surely be permitted by the country to become like France and Germany, the owners of an efficient, electrified, navigable, inland water service.

The proposed electrification of our canal system would, moreover, provide a cheap supply of electric power for export service, as well as for pumping, irrigation, ploughing, churning, milling, and vegetable and flower growth. The revivification of our inland navigable waterway system would go far towards securing a revival of our agricultural prosperity.

TECHNICAL SOCIETY NOTES.

The major portion of Mr. Marconi's lecture at the Royal Institution on Friday last dealt with familiar matter, which, in view of the scanty provision made for the press, was perhaps just as well. The magnetic detector which succeeded the coherer, and possesses a sensitiveness far beyond that of the best coherers, is no longer new, but Mr. Marconi referred to a development in connection with this detector which marks the latest advance in the domain of wireless telegraphy. The magnetic detector, as readers are aware, is capable of responding to signals at a very high rate of speed, up to some hundreds of words per minute, but it has not up to the present time been possible to work a recording instrument in conjunction with it, and much of the advantage of the speed of the detector was lost by reason of the fact that the signals received had to be read by sound.

Mr. Marconi is going to change all that. He told his audience on Friday last that he had succeeded in constructing a magnetic receiver that will work a relay and recorder, and work at a speed of some hundreds of words per minute. The advantages to wireless telegraphy of such a step in advance are obvious enough, as apart from the all-important gain in speed, the system is stated to be more simple, and to be absolutely reliable. The new receiver is stated to have been satisfactorily tested over a distance of 152 miles. Reference was made by Mr. Marconi to the effect of bright sunlight in retarding the distance over which wireless messages can be sent, but the impression that atmospheric conditions have any effect upon the speed of transmission is incorrect.

There was an interesting discussion at the Institution of Electrical Engineers on Thursday last, the subject being Mr. Donald Murray's paper on "Setting Type by Telegraph." Mr. Murray, who gave a demonstration of the apparatus, pointed out that invention in this field was outside the electrical field the reason being that the problem to be solved involved mechanical and not electrical difficulties, the electrical part of the whole thing being of exceedingly simple character. Mr. Murray is still, of course, improving his ingenious invention, and in particular he referred to possible improvements in the feed to the printer.

It was fitting that Mr. John Gavey, the engineer-in-chief to the Post Office, should open the discussion, as his department is giving a prolonged trial to the Murray apparatus. Mr. Gavey pointed out that in spite of the plethora of printing telegraphs which had been invented, the Morse system still held its ground for the major part of the telegraphic business transmitted, the reason being that the Morse alphabet was an ideal one for manual transmission. The system was costly, but quadruplex working had overcome some of the difficulties. Machine telegraphy was, however, a necessity for the transmission of press matter.

The Post Office have, it will be remembered, experimented with various machine systems, including the Rowland, the Pollak-Virag, the Mercadier, the Cried, and the Buckingham, in addition to the Murray. The Wheatstone system, as telegraph engineers are aware, is quite satisfactory as far as transmission is concerned; the faults are at the receiving end, and Mr. Gavey looks to the modern development of telegraphic instruments not only for the improved distribution of news matter, but for ordinary public messages. He hoped the Murray system would fulfil its promise of scientific working. What had impressed him most in Mr. Murray's invention was the ingenious method devised of securing synchronism.

Mr. W. Judd enlarged on the subject of alphabets, and warned all whom it might concern of the impossibility in a large telegraphic system of tampering with the alphabet. With cable messages the need for maintaining the running numbers constituted the difficulty. The question of the keyboard perforations was extremely interesting, indeed, his company was experimenting and would have one in operation in a short time. Synchronism, which in the old days had its terrors, now seemed fairly a simple problem and the cable companies were using it. It was quite true, as Mr. Murray had said, that invention in this field seemed to come from outside and the telegraph industry had benefited thereby. Mr. Higgins thought that for long distance telegraphy the Murray system might prove of considerable service, and indeed ultimately displace Wheatstone working. Mr. Mudford, who had himself been interested in a telegraphic type setting machine, gave Mr. Murray a few practical hints.

Mr. Murray, in his reply, said that if the speed of a printing telegraph was no greater than could be achieved by the Morse system, printing telegraphy would be doomed. There was, however, a good margin between the keyboard perforation and the Morse key in favour of the former. There was no competition between quadruplex working referred to by Mr. Gavey and the printing telegraph. He thought it would be possible to adapt the Murray machine to the Morse alphabet, and in that manner to meet the needs of the big cable companies with wide ramifications. The President wound up the discussion with a plea for a policy of development being adopted by telegraph engineers, who were sometimes conservative.

Reference was made during the discussion on "Overhead Mains," at the Institution of Electrical Engineers to the troubles likely to arise in connection with overhead wires which are carried along main roads. An interesting point in this connection arose at the conference of municipal tramway authorities held in London a few days ago. It was in relation to the protection of overhead trolley wires.

At the present time, when the Postmaster-General or the National Telepone Company desires to place an electric wire over those of a tramway, it becomes the duty of the tramway authority, whether a company or a municipality, to protect the live wire so that the telegraphs or telephone wire may not come in contact with it.

This, it was suggested, is throwing an unfair burden on the electric tramway interests, more particularly if the overhead equipment of the tramway should have been in position first. In such a case it might be fairly argued that the Post Office or the National Telephone Company should be charged with the duty of affording the necessary protection, and it has been decided to ask the Board of Trade to receive a deputation on this matter, and on the question of the construction of cars and other subjects in connection with the working and equipment of tramways.

"POWER."

(*A Series of Notes continued from page* 419.)

LOCO-TYPE boilers for stationary purposes are made in such a large variety of sizes that average figures taken from the whole series would be of little value as a guide for designing or selecting one of any given capacity. I purpose, therefore, to embody in succeeding notes a set of rules deduced from a very large number of examples by leading makers, which may serve as a guide to the proportions of all sizes of loco-boilers. While embodying the results of the best practice in this class of boiler, as actually made, and in successful use in every country in the world to which British manufactures penetrate, I may remark that they do not represent the practice of any one firm in particular, but have been formulated specially as a standard series of loco-type boilers for stationary use.

One word, before proceeding to the consideration of these rules for the proportions of loco-type boilers. There is, perhaps, in the whole range of engineering nothing so elastic as the locomotive boiler, hence it must not be assumed that these rules offer anything more than a consistent series known from experience to give satisfactory results. That other boilers of different proportions also give satisfactory results is more than probable.

RULES FOR THE PROPORTIONS OF LOCO-TYPE BOILERS, GRATE-AREA BEING THE UNIT.

1. *Fire-box Heating Surface* (when the grate-area is 8 square feet or less)—

Multiply the grate-area in square feet, minus 3, by 5·8, and add 14.

i.e. (if G = grate-area).

$$5{\cdot}8\,(G-3) + 14.$$

2. *Firebox Heating Surface* (when the grate-area exceeds 8 square feet)—

Multiply the grate-area in square feet by 5·5.

i.e., 5·5 G.

3. *Tube Surface* (when the grate-area is 8 square feet or less)—

Multiply the grate-area in square feet, minus 3, by 29·2, and add 54.

i.e., 29·2 (G—3) + 54.

4. *Tube Surface* (when the grate-area exceeds 8 square feet)—

Multiply the grate-area in feet by 25.

i.e., 25 G.

5. *Total Heating Surface* (Firebox and Tubes), (when the grate-area is 8 square feet or less)—

Multiply the grate-area in square feet, minus 3, by 35, and add 68.

i.e., 35 (G—3) + 68.

6. *Total Heating Surface* (Firebox and Tubes) (when the grate-area exceeds 8 square feet)—

Multiply the grate-area in square feet by 30·5.

i.e., 30·5 G.

7. *Grate-area for Burning Wood* (instead of Coal)—

Multiply the grate-area in square feet by 1·2.

i.e., 1·2 G.

8. *Flue-way, or total Sectional Area of Tubes*, in square feet (no ferules)—

Multiply the grate-area in square feet by ·15.

i.e., ·15 G.

9. *Number of Tubes* (Conditions as in Rule 11)—

(*a*) For 2½-in. tubes: Multiply the grate-area in square feet by 5·45.

(*b*) For 2¾-in. tubes: Multiply the grate-area in square feet by 4·4.

(*c*) For 3-in. tubes: Multiply the grate-area in square feet by 3·64.

(Taking the nearest whole number).

i.e. (*a*) 5·45 G; (*b*) 4·4 G; (*c*) 3·64 G.

10. *Length of Tubes*, between tube-plates, in feet (conditions as in Rule 11)—

(*a*) For 2½ in. tubes: Divide the tube-surface (Rules 3 or 4) by ·6545 times the number of tubes (Rule 9).

(*b*) For 2¾-in. tubes: Divide the tube-surface (Rules 3 or 4) by ·72 times the number of tubes (Rule 9).

(*c*) For 3-in. tubes.: Divide the tube-surface (Rules 3 or 4) by ·7854 times the number of tubes (Rule 9).

i.e. (*a*) $\dfrac{\text{Tube Surface}}{{\cdot}6545\ (\text{No. of Tubes})}$ for 2½-in. tubes.

(b) $\frac{\text{Tube Surface}}{\cdot 72\,(\text{No. of Tubes})}$ for 2¾-in. tubes.

(c) $\frac{\text{Tube Surface}}{\cdot 7854\,(\text{No. of Tubes})}$ for 3-in. tubes.

11. *Diameter of Tubes* (external) in inches)—

(a) For grate-areas of 8 square feet or less, 2½ in.

(b) For grate-areas from 8 to 18 square feet, 2¾ in.

(c) For grate-areas exceeding 18 square feet, 3 in.

12. *Height of Firebox*, measured inside (from level of grate-bars) in inches—

Multiply the square root of the grate-area in square feet by 14·7.

i.e., $14{\cdot}7\sqrt{\text{grate area}}$.

13. *Diameter of Chimney*, in inches—

Multiply the square root of the grate-area in square feet by 4·4.

i.e., $4{\cdot}4\sqrt{\text{grate area}}$.

14. *Coal Consumed* per square foot of grate, in pounds per hour—

Multiply the grate-area in square feet, minus 3, by ·64, and add 20.

i.e., $\cdot 64\,(G-3) + 20$.

15. *Water Evaporated* per pound of coal from and at 212°, in pounds—

(a) When the grate-area is 8 square feet or less: Multiply the grate-area in square feet, minus 3, by ·348, and add 7.

(b) When the grate-area exceeds 8 square feet: Multiply the pounds of coal consumed by 9.

i.e. (a) $\cdot 348\,(G-3) + 7$.

(b) 9 (pounds of coal).

16. *Approximate Weight* of Boiler, in cwts., including ashpan and stool, firebars, chimneys, and all fittings—

Multiply the grate-area in square feet, minus 3, by 9·3, and add 30.

i.e., $9{\cdot}3\,(G-3) + 30$.

17. *Effective Horse-power* of Boiler, may (for use with simple non-condensing engines) be taken as $\frac{1}{40}$ of the total evaporation in pounds per hour.

$$i.e.,\ \frac{\text{Total water evaporated per hour in lbs.}}{40}$$

18. *Suitable Diameter of Cylinder* (Piston speed being taken as 300 ft. per minute, and steam-pressure as 100 lb)—

(a) For single-cylinder engines: Multiply the horse-power (Rule 17) by 4, and extract the square root.

(b) For double-cylinder engines: Multiply the horse-power (Rule 17) by 1·8, and extract the square root.

i.e. (a) $\sqrt{4 \times \text{h.p.}}$

(b) $\sqrt{1{\cdot}8 \times \text{h.p.}}$

Shipbuilding Notes.

Two more submarine boats of the "A" class, built by Messrs. Vickers, Sons, and Maxim, were launched at Barrow on Wednesday.

The new Royal Mail liner *Aragon* is expected to be ready for sea about the end of June, and the second mail boat, also building at Belfast, will follow about four months later, in time for the busy season in the winter.

THE S.S "BOSANKA."

The fine steel screw steamer *Bosanka*, built by the Northumberland Shipbuilding Company, Ltd., Howdon-on-Tyne, to the order of The Navigazione a Vapore "Napried," Rugusa, Dalmatia, recently left the Tyne for her trial trip. The steamer is 351 ft. long by 46 ft. 10 in. beam by 27 ft. 4 in. deep, and has been built under special survey to the highest class at Lloyd's Single Deck Rule. She is fitted with long poop, long bridge and topgallant forecastle, the accommodation which is very ample, being placed in steel houses on the bridge deck. Very special attention has been paid to the loading and discharging gear and a complete outfit for the rapid handling of cargoes has been arranged for, consisting of powerful steam winches by Messrs. Clarke, Chapman and Co., Ltd., Gateshead-on-Tyne, and a large number of cargo derricks, steam steering gear by Messrs. The Harrison Engine Company, Ltd., Manchester, and steam windlass by Messrs. Emerson, Walker and Thompson Bros. She is fitted with the usual water-ballast arrangement for light passages. The vessel has been constructed to a fine model with a view to rapid speed and economy in fuel, and the machinery has been supplied by the North-Eastern Marine Engineering Company, Ltd., consisting of engines with cylinders 24 in., 40 in., and 65 in., by 45 in. stroke, two large steel boilers 15 ft. 9 in. by 10 ft. 6 in., 160 lb. working pressure. The steamer will carry about 6,000 tons loaded. During construction the *Bosanka* has been superintended by Mr. R. Baird and Mr. Burt, on behalf of the owners, and Mr. A. E. Hunt representing the Austrian Veritas. The trial trip proved in every way satisfactory, a speed of 11 knots being easily obtained. Among the guests on board were the following: Mr. Mararnovich, managing owner; Mr. Roland Hodge, managing director, and Mr. J. Graham, manager for the builders; Mr. Myles representing the engine builders, Messrs. Manasteriotte, A. E. Hunt and J. F. Slater. After the trial trip the s.s. *Bosanka* sailed under the command of Captain Arnenich for Cardiff, where she will load for Sebenico.

OLYMPIA MOTOR SHOW.

(*Continued from page* 462.)

WILLANS AND ROBINSON.

THE increasing interest which leading engineering firms are manifesting in the motor industry is, it need hardly be said, destined to prove of material advantage in the forthcoming development of what is still a new branch of manufacture, and the exhibit of this firm at Olympia, whose cylinders and other castings for motor-cars have attracted special attention, calls, therefore, for more than passing notice.

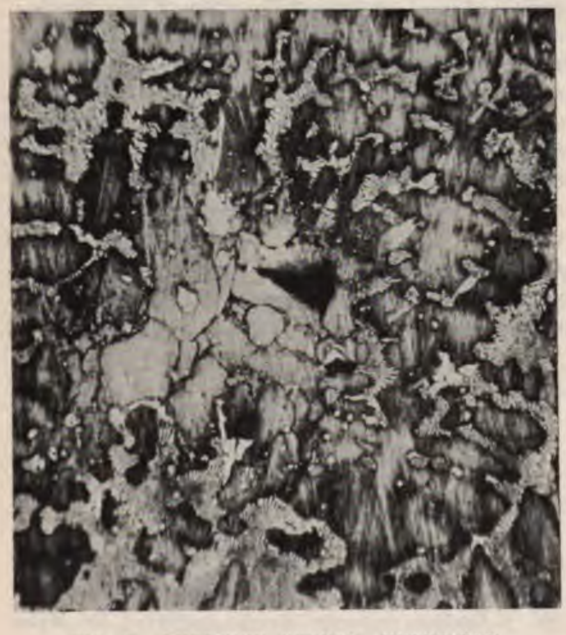


FIG. 1. PHOSPHOR BRONZE, UNTREATED. MAGNIFIED 150 DIAMETERS.

Transverse section. A polished surface of the metal is first prepared, and the structure afterwards developed by treatment with nitric acid.

For some years Willans and Robinson have conducted a series of experiments upon varieties of vanadium steel. The outcome of these experiments has been the consistent production in commercial quantity of types of steel exceptionally suitable for use in motor-car construction.

The most exhaustive tests have been applied to these steels, and their behaviour under wide changes of temperature has also been fully studied. In addition, experience of their practical behaviour, gained on many tons, and over a period of upwards of a year, has been obtained. The results in detail of these investigations were recently submitted to the Institution of Mechanical Engineers by Captain Sankey, and Mr. Kent Smith, a lengthy abstract of which paper, with illustrations, was reproduced in PAGE'S WEEKLY for December 30th, 1904.

This firm is also introducing a new method of treatment for alloys for bearing purposes, an all-important one to all users of machinery, including automobilists. The results of experiments have yielded what may be fairly termed remarkable results, and the whole secret lies in the fact that the treatment entirely obviates the trouble due to the segregation of the different constituents of the alloys, and a practically complete equality in the structure of the mass of the bearing is obtained and a consequent equal distribution of the load spread over the wearing surface of the bearing, increasing its durability and anti-frictional properties to an extraordinary degree.

The most noticeable features to be observed in the bearings cast by this method are complete freedom from sponginess, perfect homogeneity, and increased density. The complete homogeneity ensures a wearing surface of perfectly mixed constituents of the alloy, so that one does not find after a little while that the softer places have worn down and left the hard places raised up. There is instead a complete equal distribution of the load over the wearing surface. One point, by no means the least important, to be observed by automobilists and engineers, is the great decrease in power to drive any shaft running in bearings treated by this method as compared with ordinary bearings, thus considerably increasing the mechanical efficiency of the machine. These remarks apply in exactly the same way to white metal, phosphor bronze, gunmetal, and yellow brass. Even in white metal the tensile strength is increased some 50 per cent., and in phosphor bronze, gunmetal, and yellow brass, the increase in the tensile strength and elongation is most remarkable.

In figs. 1 and 2 are shown reproductions of micrographic sections, one No. 4,926, magnified 150 diameters, showing a casting in phosphor bronze cast in the ordinary way, and No. 4,927, showing a section of exactly the same material, but treated by the special method.

Another important point is the great resistance to crushing strains shown by all alloys cast by this method, which is remarkably evidenced in bearings for gas engine work. It is also shown that by this method less expensive alloys can be made to give results on bearings very superior to those at present obtained with more costly mixtures.

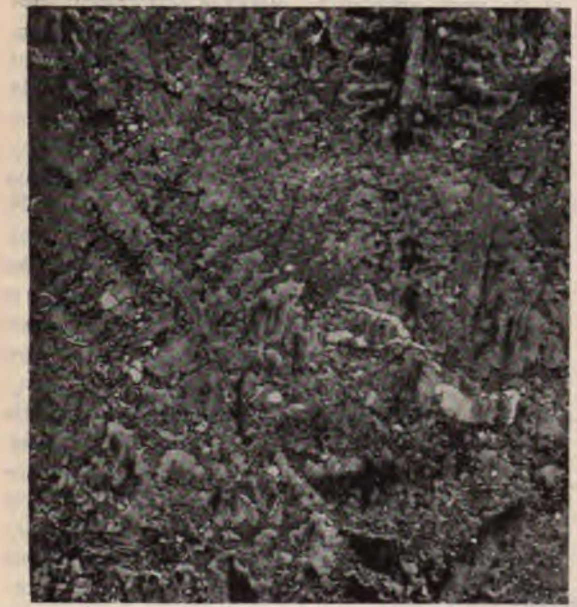


FIG. 2. PHOSPHOR BRONZE, TREATED.
MAGNIFIED 150 DIAMETERS.

Transverse Section.

WINTON MOTOR CARRIAGE COMPANY.

This company, which has its works at Cleveland, Ohio, sent an interesting exhibit to Olympia. The construction of the car is such as to give easy facilities for interchangeable bodies, and this feature was the subject of favourable comment. There are other points about the cars which give them distinction. One is the Winton spring, illustrated in fig. 6. It is of the semi-elliptic type, and as will be noted in the illustration, twin three-leaf springs are shackled together (at 198) and attached to the frame (at 199 and 202). With a light load the upper spring alone is in service. The lower spring is in reserve until the weight of the load increases to a point where the upper spring tends to straighten out. Then the lower spring comes into play, and, acting in company with the upper spring, forms a combination of sufficient resistance and resilience for any load likely to be carried. The prime advantage of this twin spring is that it combines, for varying loads, both resilience and resistance.

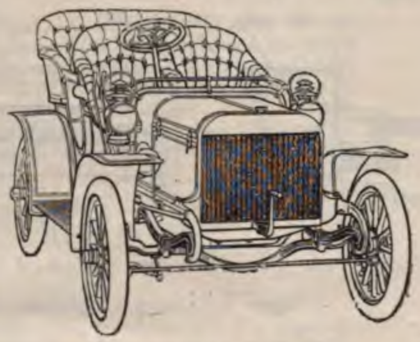


FIG. 3. WINTON MODEL.

The oiling arrangement shown in fig. 5 displays ingenuity in design, and the principle is, we think, new in its application to motor-cars. From the reservoir above the cylinders, lubricating oil is fed by gravity to the automatic lubricator, being received in a float chamber, whereby a constant level is maintained and oil flow prevented when motor is not running. From this chamber oil passes into the main chamber

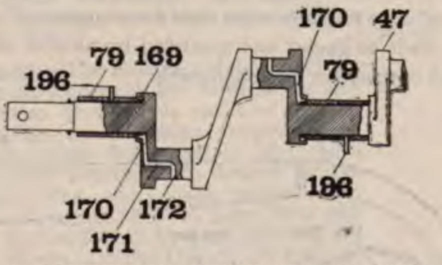


FIG. 4. SHOWING OIL SYSTEM FOR CRANKSHAFT.

of the lubricator, where a gear-driven aluminium roller revolves in it. The viscosity of the oil being variable with the temperature, the thickness of the oil film on the roller would increase as the temperature decreased, resulting in an excess of oil at low temperature. To provide against this condition, an adjustable metallic scraper carries off the superfluous oil, limiting the thickness of the film to the distance between the scraper and the roller. Passing this scraper, the oil film engages a second scraper, in contact with the roller, by which it is directed in equal quantities through the ten oil leads extending to all the bearings of the motor and of the rear axle. This system of lubrication is designed to provide an oil feed in exact proportion to the motor speed. Cylinders 2, 4, 5, and 6 carry oil to the four-cylinder. The crankshaft and the connecting-rod bearings are lubricated by direct feed (fig. 4). The oil is carried by cylinders 7, 8, 9 and 10 from the oiler to the stationary bearings of the crankshaft bearing, lubricating the crank, and then passes through a groove to a channel which leads to the inside of each connecting-rod bearing.

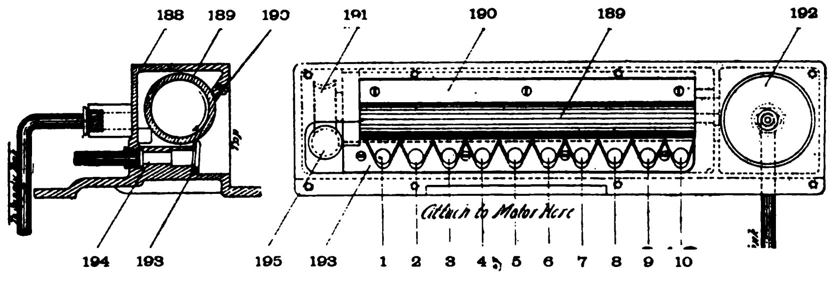


FIG. 5. WINTON OIL SYSTEM.

A Winton car model is shown in fig. 3. The frame is of stamped steel, and no malleable castings are used, steel drop forgings being used for all parts. Every part is made to gauge, and identified by number or letter, and is therefore interchangeable.

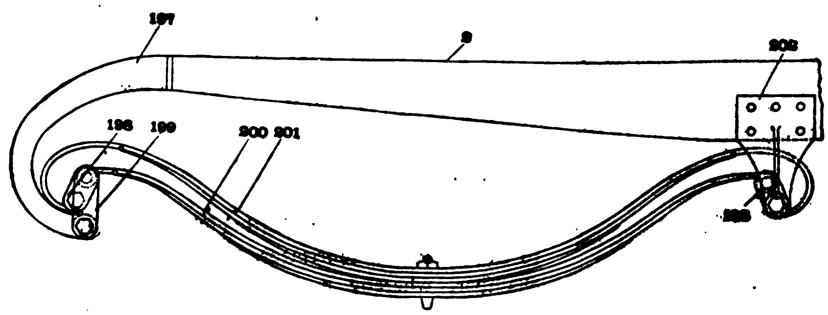


FIG. 6. WINTON SEMI-ELLIPTIC THREE-LEAF SPRING.

FOREIGN SHIPPING SUBSIDIES.

Mr. F. Shadforth Watts, the newly elected president of the Chamber of Shipping of the United Kingdom, in the course of his recent address to that body, said that during the past few months, orders for new tonnage had been given out so freely that he was afraid the hoped-for revival in freights was not now even within measurable distance. On the question of foreign shipping subsidies, he said there was no doubt that sooner or later the United States Government would pass a Shipping Subsidy Bill calculated to cause a rapid increase in the mercantile tonnage under the United States flag. He was told that the Bill now before Congress was not likely to pass this session; but, as an indication that early legislation might be expected, he thought it was significant that a contract for the carriage of coal from Norfolk to Manila was recently awarded to American shipowners on the basis of $7 per ton by steam and $6.50 per ton by sail, as against tenders at $4.20 made by British ship owners. The inducement to add largely to the existing tonnage of the world afforded by means of Government subsidies was a great menace to the British shipping trade, but he was afraid that it was unlikely that mere representations to foreign Governments would have any effect unless and until His Majesty's Ministers were in a position to back up their representations by alternative retaliatory measures. The following resolution was subsequently passed on the motion of Mr. Herron: "That, in view of the bounties now granted by some foreign Governments to their ships, and of the legislation proposed in the United States of America, with the object of subsidising American shipping at the expense of foreign shipping, this chamber desires to call the attention of His Majesty's Government to the disadvantages under which British shipping is placed, and requests that His Majesty's Government will take steps to obtain the withdrawal of existing bounties and prevent the granting of further bounties."

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts.

CONTRACTS OPEN.

	Last Day.
Broadstairs.—Construction, delivery, and erection at the above station of a horizontal tandem compound engine, condenser, well pumps, and all accessories. Mr. Percy Griffith, M. Inst. C.E., 54, Parliament Street, S.W.	March 11
Brighouse.—Widening of the Calder Bridge, Brighouse, by means of steel lattice girders and steel stanchions for the Corporation. Mr. S. S. Haywood, Borough Engineer, Municipal Offices, Brighouse ...	March 11
Belgium.—The "Bulletin Commercial" announces that the Belgian State Railways invite tenders for the installation of a set of ventilating and heating apparatus in the central workshops at Mechlin. Particulars of M. Slaghmuylder, Engineer-in-chief, Station du Nord, Brussels ..	March 13
Park Royal.—Supply, delivery, and erection of plant in connection with the electricity generating station at Park Royal and proposed sub-stations and distributing centres at various places, for the Great Western Railway Company. Messrs Kennedy and Jenkin, 17, Victoria Street, S.W.	March 13
Axbridge (Somerset).—Supply of about 600 tons of cast-iron socket water-pipes 7-in. to 4-in in diameter, for Axbridge Union Rural District Council	March 13
Cromer.—Supply and erection of a steam boiler for Urban District Council at new pumping station at Wetton. Mr. J. C. Melliss, M.Inst.C.E., Gresham House, Old Broad Street	March 13
South Shields.—Supply, delivery and erection of the following plant in connection with the electricity supply department:—One multitubular marine type boiler, two medium-speed open-type vertical engines for two 550 k w. direct current traction generators, two 500 k.w. direct current generators and traction switchboard. Mr. J. H. Cawthra, Borough Electrical Engineer	March 13
Llandyfodwg and Llantrisant (Wales). The Ogmore and Garw Urban District Council invite tenders for two distinct and separate schemes of bridging the valley at Gilfach, by extending Coronation-road, Evanstown, in the parish of Llandyfodwg, to join the highway known as Gilfach-road, in the parish of Llantrisant Mr. H. Dawkins Williams, Surveyor, Bryn, Menin	March 14
Gloucester.—Supply and erection of three Lancashire boilers and accessories, one 600 k.w. generator set and accessories, electrically-driven surface condensing plant, boiler feed pump, etc. Mr. J. Sheffield Blakeway, Town Clerk ...	March 16
Liverpool.—Construction of covered conduit about 1,100 yards in length, and other works connected therewith, situated in the townships of Withnell and Wheelton, in the county of Lancaster, for the Water Committee of the Liverpool Corporation. Mr. H. Dawkin Williams, Surveyor, Bryn Menin	March 14
London.—Supply of electrical stores for year ending March 31, 1906, for the Fulham Borough Council. Town Clerk, Town Hall, Fulham...	March 15
Peterborough.—Supply and erection of the following plant, for the Corporation: (Section No. 1) Lancashire boilers, superheaters and economiser; (Section No. 2) triple expansion vertical engines, pumps, electric lighting set, travelling crane, workshop fittings, and tools; (Section No. 3) piping, injector, feed pump, tank, and feed-water softener. Mr. John C. Gill, Waterworks Engineer's Office, Peterborough	March 23.
Welwyn.—Supply and delivery of about 58 tons of 9-inch cast-iron pipes, for the Welwyn (Herts) Rural District Council. Messrs. Herbert Walker and Son, Albion Chambers, King Street, Nottingham ...	March 27
Grindleford and Rowsley.—Construction of the Grindleford to Rowsley section of the Derwent aqueduct, in the county of Derby, for the Derwent Valley Water Board. Mr. Edward Sandeman, Engineer, Bamford, Sheffield	March 27
Bolton.—Supply and erection of cooling tower and condensing apparatus in connection with power station, for the Electricity Committee. Mr. Arthur A. Day, borough electrical engineer, Spa Road, Bolton	March 30
Shanghai.—The Shanghai Municipal Council invite tenders for the construction and operation of about 24 miles of electric tramways on the trolley system in the streets of the Settlement of Shanghai; alternative proposals are desired for the single-trolley and double-trolley lines. Council's agents, Messrs. John Pook and Co., 63, Leadenhall Street, London, E.C., and Messrs. Fearon Daniel and Co., 90, Wall Street, New York.	March 31
Newport (Mon.).—Construction of main outfall and branch sewers for the Western Valleys Sewerage Board. Particulars at offices of Mr. Baldwin-Latham, Parliament Mansions, Victoria Street, S.W.; Mr. Geo. Chatterton, 6, The Sanctuary, Westminster, S.W.; or Mr. T. S. Edwards, Clerk to the Board, Newport (Mon.) ..	April

COMING CONTRACTS.

Stirling.—The Secretary for Scotland has sanctioned the borrowing of £41,000 for electric lighting extensions.

Crewe.—A sub-committee has been appointed in connection with the borough surveyor's plans of a proposed new southern outfall sewer and disposal works, which are estimated to cost £60,000.

Aylsham.—The provision of waterworks, estimated to cost £5,000, is under consideration.

Bath.—The Council have adopted a report recommending the extension of the continuous-current generating plant at a cost of £3,000.

Wimbledon.—Application is to be made for sanction to borrow £13,218 for additional plant and extensions at the electricity works.

Plymouth. — An inquiry has been held into the Corporation's application for sanction to a further loan of £65,000 for the main drainage scheme.

South Shields.—The Council have under consideration the question of placing orders for motor omnibuses.

Ormskirk. — The Council have now adopted an electric lighting scheme, which includes the provision of a refuse destructor, and is estimated to cost £20,000.

CONTRACTS CLOSED.

Cape Town.—Cowans, Sheldon, and Co., of Carlisle have just completed the construction of a large crane, to be used in extending the harbour at Cape Town.

Lancaster.—The Lancaster Corporation have placed an order with the British Westinghouse Co. for two tramcars at £570 each.

Leith.—The Leith Tramways Reconstruction sub-committee have accepted the tender of M. P. Galloway, Ltd., for supply of tramway poles and accessories at £4,471.

Birkenhead.—The Power-Gas Corporation, Ltd., have been awarded a contract by the Tranmere Bay Development Company, Ltd., of Birkenhead, for a gas-driven electric installation for the latter company's new shipyard at Birkenhead.

Dartmouth.—A. and J. Main and Company, Ltd., of the Clydesdale Ironworks, Possilpark, Glasgow, are supplying the steel buildings complete for the new workshops for the Britannia Royal Naval College, Dartmouth.

Glasgow.—The Steel Company of Scotland, Ltd., Glasgow, have ordered from Mr. P. J. Mitchell, engineer, 52, Queen Victoria Street, E.C., a complete installation of Rateau patent exhaust accumulator regenerators, together with the necessary turbo-generating plant, condensers, cooling-tower, etc.

Manchester. — The Lancashire Electric Power Company, of Manchester, have contracted for the supply of current for the complete driving of the cotton-mill which is being built by the Acme Spinning Company, of Pendlebury. The mill will contain 41,000 mules and 34,000 ring spindles.

Stockport.—R. W. Blackwell and Co. are supplying the overhead equipment for the electrification of the Hazel Grove Route of the Stockport tramways for the sum of £4,343. The company's tender was the lowest, the next being that of the British Electric Company, at £4,683.

London.—The Brush Electrical Engineering Company, Ltd., have secured the following contracts: three 50 k.w. three-phase transformers for Sir W. G. Armstrong, Whitworth and Company; complete steam and electrical plant for power house for Leamington and Warwick tramways; three double-deck cars with radial trucks and Brush motor equipments for Airdrie and Coatbridge tramways.

APPOINTMENTS VACANT.

	Last Day.
Tredegar.—Gas and water works' Engineer under Tredegar Urban District Council...	March 20
Llanelly.—General superintendent of harbour, docks, and railways under Llanelly harbour trustees. Salary, £300 per annum	March 16
London.—The Corporation of London invite applications for the office of Engineer to the Public Health Department. Salary £1,000 per annum, rising to a maximum of £1,500 per annum. Candidates must be Members of the Institution of Civil Engineers. Associate Member of the Institution of Civil Engineers is not a sufficient qualification. Full particulars of the duties of the office and form of application may be obtained from the Town Clerk, Guildhall, E.C.	March 18
Leeds.—Lecturer in Civil Engineering at the University. Salary, £300 per annum. The appointment to date from either April 1st, or October 1st. Particulars of Registrar at University	March 25
Madras.—Assistant Engineer. The Madras Railway Company require an Assistant Engineer on an engagement for three years. Commencing salary, Rs. 350 per month. Apply: Secretary, Madras Railway Co., 1, Broad Street Place, E.C.	March 18
Bombay.—The Bombay, Baroda, and Central India Railway Co. invite applications for appointment as chief draughtsman in the carriage and wagon department of the Company's service. Salary, Rs. 250, rising to Rs. 300 per month. Apply: Secretary, Gloucester House, Bishopsgate Street, E.C.	March 22

APPOINTMENTS FILLED.

Rhodesia.—Mr. W. J. Hosgood, the engineer and locomotive superintendent of the Port Talbot Railway and Docks, South Wales, has been selected for the position of chief mechanical engineer of the Rhodesian Railways.

District Railway.—Charles A. King, permanent-way engineer of the Glasgow tramways, has been appointed to a similar position with the Metropolitan District Railway.

Johannesburg.—Mr. J. H. Dobson, formerly an apprentice in Crewe Railway Works, has been appointed to the Professorship of Electro-technics at the Transvaal Technical Institute, Johannesburg.

Ayr.—Mr. William Grant, tramway manager, Rotherham, has been appointed manager of the Ayr Corporation tramways. Mr. Grant has had twelve y experience of tramway work under the Corporat of Blackpool, Darwen, and Rotherham.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

e following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares business is currently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our List will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from e inaccuracies.

STOCK EXCHANGE SETTLING DAYS.—Settling days on the Stock Exchange are as follows :—

sols: April 5th. General Settlements: March 15th, 30th, April 13th. Bank Rate, April 21st, 1904, 3 per cent.

—ENGINEERING, IRON, AND STEEL COMPANIES.

d.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
0	5	5%	Alldays & Onions Pneumatic Engineering, Ltd.	3	2½— 3
0	5	3/-	Do. Cum. Pref. 6 per cent. ..	5	4½— 5
0	1	2/6	Armstrong (Sir W. G.), Whitworth and Co., Ltd.	1	3 3/16— 3 5/16
0	5	2/-	Do. 4% Cum. Pref.. ..	5	5⅜— 5⅝
0	100	4%	Do. 4% 1st Mort. Dbs. Rd.	100	104 —106
0	100	4½%	Aveling and Porter, Ltd., 4½% Reg. Mt. Debs. Red.	100	96 — 99
0	1	1/7⅕	Babcock and Wilcox, Ltd., Ord. ..	1	4⅛— 4⅜
0	1	7⅕d.	Do. ,, 6% Cum. Pref.	1	1½— 1⅝
0	5	3/-	Baker (Joseph) and Sons, Ltd., 6% Cum. Pref.	5	5 — 5½
0	1	6⅗d.	Baldwins, Ltd., 5½% Cum. Pref. ..	1	1 — 1⅛
0	Stk	4½%	Do. 1st Mt. 4½% Deb. Stk. Red.	100	101 —103
0	4½	2/8⅖	Barrow Hæmatite Steel Co., Ld., O.	4½	1 9/16 — 1 11/16
0	4½	6/-	Do. do. Cum 2nd. Pref.	4½	4⅜— 4⅝
4	5	2/6	Bayliss, Jones and Bayliss, Ltd., 5% Cum. Pref. Shares	5	4¾— 5¼
0	100	—	Beardmore (Wm.) & Co., Ltd., 4½% 1st Mt. Debs., Red., Scrip 50% pd	—	102 —104
0	10	6/-	Bell Brothers, Ltd., 6% Cum. Pref.	10	11¾— 12¼
0	Stk	4%	Do 4% Deb. Stock, Red.	100	99 —101
0	1	1/-	Beyer, Peacock and Co., Ltd., Ord.	1	21/32 —22/32
0	1	6⅗d.	Do. 5½% Cum Pref.	1	21/32 — 22/32
0	Stk	4½%	Do. 4¼% Red. Deb. Stock	100	94 — 97
0	1	6d.	Bolckow, Vaughan and Co., Ltd., O. Nos. 1-1,629,760	1	1 —1 1/16*
0	1	3⅗d.	Do. Nos. 1,639,101-3,500,000	12/-	17/32— 19/32*
0	1	4⅘d.	Brown (John) and Co., Lim., Ord., Nos. 1-1,160,000	15/-	1 3/16— 1 5/16
0	1	6d.	Do. Ord., Nos. 1,160,001-1,750,000	1	1 23/32— 1 27/32
0	10	5/-	Do. 5 % Cum. Pref.	10	11¼— 11¾
0	5	2/6	Cammell, Laird & Co., Ltd., Ord. ..	5	8¼— 8¾
0	5	2/6	Do. 5% Cum. Pref. ..	5	5 7/16— 5 9/16
0	1	1/6	Clayton & Shuttleworth, Ltd., Ord.	1	15/16— 1
0	5	2/6	Do. 5% Cum. Pref.	5	5⅜— 5⅝
0	Stk	4%	Do 4% 1st Mort. Db. Stk. Red	100	100 —102
0	10	7/6	Consett Iron Co., Ltd., Ord.. ..	7½	32— 33
1	10	10/-	Crossley, Bros., Ld., Ord. 40340/97370	10	16½—16¾
9	10	5%	Do. 5% Cum. Pref.	10	11½—11¾
0	1	2/6	Delta Metal, Ltd. Shares	1	2⅛— 2¼
4	1	3⅗d.	Dorman, Long & Co., Ltd.	1	⅝— 11/16
0	Stk	4%	Do. 4% 1st Mort. Perp. Deb. Stk.	100	91 — 94
0	5	3/-	Dunderland Iron Ore Co., Ltd., 6% Cum. Pref. and Participating..	5	3⅜— 3⅝
0	1	9⅗d.	Dunlop (James) & Co., Ltd., Ord...	1	⅝— ¾
0	1	7⅕d.	Do. 6% Cum. Pref. ..	1	15/16 - 1 1/16
1	13	12/-	Ebbw Vale Steel, Iron & Coal Co., Ltd.	13	9 — 10
4	13	12/-	Do. do. do.	10	7⅜— 7⅝
0	10	8/-	Elliott's Metal, Ltd.	8	4½— 5½
0	10	5%	Do. Cum. Pref. 5%	10	8¾— 9¼
8	Stk	4%	Do. Deb. 4%	100	94½ - 96½
0	10	6/-	Fairfield Shipbuilding & Engng.Co., Ltd., 6% Cum. Pref. ..	10	10½— 11
0	Stk	4½%	Do. 4½% Mort. Deb. Stk. Red.	100	97 —100
0	10	10%	Fleming & Ferguson, Ltd, Ord. Nos. 1/9000..	10	12½—12¾
00	10	5%	Do. 5% Cum. Pref. Nos. 9001/15000	10	9½—10
00	3	3/-	Fraser & Chalmers, Ltd., Ord. ..	3	4⅝— 4⅞
00	3	1/6	Do. 7½% Cum. Pref.	3	5¾— 6¼
00	10	5%	Galloways, Ltd., 5% Cum. Pref. 18001/28000	10	6 — 7
00	Stk	4%	Do. 4% 1st Mort. Deb Red..	100	90½—91½
00	10	—	Greenwood & Batley, Ltd., Ord. ..	10	4 — 4¼
500	10	7%	Do. 7% Cum. Pref.	10	10¼— 10¾
00	1	1/-	Guest, Keen & Nettlefolds, Ltd. Ord.	1	2 5/16—2 7/16*
00	5	2/6	Do. 5% Cum. Pref.	5	5⅞— 6⅛*
00	Stk	4%	Do. 4% Irred. Mort. Deb. Stk	100	106 —108
00	5	2/6	Gwynnes, Ltd., 5% Cum. Pref. ..	5	2 — 3
00	1	1/-	Hadfield's Steel F'dry Co., Ld., Ord.	1	3 5/16— 3 7/16
00	10	4/6	Do. 4½% Cum. Pref.	10	10¾ — 11¼
00	5	3/-	Hall (J. & E.), Ltd. 6% Cum. Pref...	5	5 — 5½
05	1	1/6	Harvey United Steel Co., Ltd. ..	1	1 7/16— 1 9/16
00	10	7½%	Hawthorn, Leslie & Co., Ltd. Ord.	10	10¾— 11
01	5	7/-	Head, Wrightson & Co., Ltd. ..	5	4¾— 5¼
00	1	7⅕d.	Hill (Richard) & Co. (1899) Ld., Ord.	1	⅝— ¾
00	5	3/-	Do. 6% Cum. Pref.	5	4⅝— 4⅞
00	10	6/-	Hornsby (Richard) & Sons, Ld., Ord.	8	5½— 6

ENGINEERING, IRON, AND STEEL COMPANIES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices
750,000	1	6d.	Howard & Bullough, Ltd., Ord. ..	1	1⅝ — 1¾
25,000	10	6/-	Do. 6% Pref. (Non-Cum.) ..	10	12¾— 13¼
£250,000	Stk	4%	Do. 4% Deb. Stk., Red. after 1905	100	98 —101
37,500	10	20	Kynoch, Ltd.	10	18¾— 19¼
49,537	10	5%	Do. Cum. Pref. 5%	10	10¾— 11¼
300,000	1	4⅘d.	Lambert Bros., Ltd., Ord.	1	⅝— ⅞
50,000	5	2/9	Do. 5½% Cum. Pref.	5	4 — 4½
40,000	3	2/1⅕	Leeds Forge Co, 7% Cum. Pref. ..	3	3¾— 4¼
200,000	1	7⅕d.	Lysaght (John), Ltd., 6% Cum. Pf.	1	1 5/16— 1 7/16
£300,000	Stk	4½%	Do 4½% 1st Mt. Deb. Stk., Red.	100	108 —110
40,000	10	5/-	Mather & Platt, Ld., 5% Cum. Pref	10	11 —11½*
210,000	1	8⅖d.	Measures Bros., Ltd., Ord.	1	⅝— ¾*
75,000	1	6⅗d.	Do. 5½% Cum. Pref.	1	13/16— 15/16*
£75,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	94 — 97
21,943	5	2/6	Muntz Metal, Ltd.	5	5⅜— 5⅝
14,248	5	5%	Do. Pref. 5%	5	5⅛— 5⅜
5,000	62½	47/6	Nantyglo and Blaina Iron Works, Ltd., 8% Cum. Pref.	62½	76 — 80
73,000	10	5/-	N. Brit. Loco. Co., Ltd., 5% Cm. Pf.	10	12⅛— 12⅜
80,000	5	—	North-Eastern Steel Co., Ltd., Ord.	5	—
£250,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	90 — 93
122,000	5	2/-	Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B"	5	4⅛— 4⅜
50,000	5	3/-	Do. 6% Cum. Pref. "A" ..	5	5¾— 6¼
70,000	10	6/-	Pease & Partners, Ltd., Ord. ..	10	10½— 11
£400,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	97 —100
20,000	5	3/-	Peebles (Bruce) & Co., Ld., 6% Cm. P.	5	4¾— 5
65,000	1	—	Pooley (Henry) & Son., Ltd., Ord ..	1	6/6— 7/-
13,000	5	—	Do. 5½% Cum. Pref.	5	4 — 4¼
230,000	1	—	Projectile Co. (1902), Ltd., Ord. ..	1	½— ⅝
126,938	5	2/-	Rhymney Iron Co., Ltd.	5	1⅞— 2
73,062	5	2/-	Do. New	5	1½— 1¾
£330,000	—	5%	Do. 5% Mort. Deb., Red. ..	100	100 —102
350,000	1	7⅕d.	Richardsons, Westgarth & Co., Ltd., 6% Cum. Pf. ..	1	⅞— 15/16
£350,000	Stk	4½%	Do. 4½% Perp. Deb. Stock ..	100	94 — 96
35,000	10	12/-	Ruston, Proctor & Co., Ltd... ..	10	9½— 10
275.000	1	6d.	Scott (Walter), Ltd., Ord.	1	13/16— 15/16
300,000	1	7⅕d.	Do. 6% Cum. Pref. ..	1	1— 1⅛*
£300,000	Stk	4%	Do. 4% Perp. Deb. Stk.	100	94 — 96
£115,300	100	5%	Shelton Iron, Steel and Coal Co., Ld. 1st Charge 5% Debs.. Red ..	100	91 — 94
£97,900	100	6%	Do. 6% 2nd Mort. Debs., Red.	100	91 — 95
250,000	1	1/-	South Durham Steel & Iron, Ltd. Or.	1	⅝— 11/16
300,000	1	7⅕d.	Do. 6% Cum. Pref...	1	15/16 — 1
£300,000	Stk	4½%	Do. 4½% Per. Deb. Stock	100	90 — 93
49,560	10	2½%	Steel Co. of Scotland Ord. 1/49560..	9	5 — 5½
£125,240	Stk.	5%	Do. 5% Trust Mort. Deb. ..	100	106½—107½
25,000	10	—	Stephenson (Robert) & Co., Ltd., Or.	10	1¾— 2¼
25,000	10	5/6	Do. 5½% Cum. Pref. ..	10	3¾— 4¼
£250,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	84— 85
85,000	10	9/-	Stewarts & Lloyds, Ltd., Ord. ..	10	17¼— 17¾
55,000	10	6/-	Do. 6% Cum. Pref.	10	14¼— 14¾
634,732	1	4.69d.	Swan, Hunter & Wigham-Richardson, Lim. Ord.	1	¾— ⅞
538,845	1	6d.	Do. 5% Cum. Pref.	1	15/16— 1 1/16
£240,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Red	100	98 — 101
300,000	1	6d.	Thames Iron Works, Shipbuilding & Engineering Co., Ltd., 5% Cum. Pf.	1	½— 9/16
£200,000	100	4%	Do. 4% Irredeem. 1st Mort. Deb.	100	67 — 71
£160,000	1	7⅕d.	Thornycroft (John I.) & Co., Ltd. 6% Cum. Pref.	1	15/16— 1 1/16
10,000	10	5/-	Tylor (J.) & Sons, Ltd. 5% Cum. Pf.	10	9½— 10
$508495200	$100	$½	United States Steel Corp. Com. Stk.	$100	37 — 37¼
$360314100	$100	$1¾	Do. 7% Cum. Pref. Stock	$100	98 — 98½
$162268000	$1000	5%	Do. 10-60yr. 5% Skg. Fd. G. Bds.	$1000	97 — 99
3,350,000	1	1/-	Vickers, Sons & Maxim, Ltd. Ord..	1	2½ — 2⅝
750,000	1	6d.	Do. 5% Non-Cum. Pref. ..	1	1 3/16 — 1 5/16
£750,000	Stk	5%	Do. 5% Non-Cum. Pref. Stock.	100	115 —118
£1,250,000	Stk	4%	Do. 4% 1st. Mort. Deb. Stk. Red.	100	106 —108
£1,000,000	100	4½%	Do. 4½% 2nd Mort. Debs., Red.	100	105 —107
225,000	1	1/2⅖	Weardale Steel, Coal & Coke, Ltd., Def. Ord.	1	⅝— ⅞
500,000	1	7⅕d.	Do. 6% Cum. Pref. Ord. ..	1	⅞— 1
£300,000	Stk	4%	Do. 4% Perpetual Deb. Stock	100	85 — 89
7,637	5	2/9	Weldless Steel Tube, Ltd., Cum. Pref. 5½	5	4⅜— 4⅞
300	Stk	4½%	Do. Mort. Deb. 4½%	100	91 — 97
66,666	5	3/.	Willans & Robinson, Ord.	5	1½— 2½
66,666	5	3/-	Do. 6% Cum. Pref.	5	3 — 4
£246,641	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red	100	78 — 83
£150,000	Stk	4½%	Yorkshire Iron & Coal Co., Ltd., 4½% 1st Mort. Deb. Stk. Red.	100	[illegible]

Stocks and Shares marked * are quoted ex-dividend.

II.—ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name	Paid up.	Closing Prices.
70,000	1	6d.	Alliance Elec. Co., Ltd. 5% Cum. Pf.	1	⅝— ⅞*
125,000	1	7½d.	Aron Elec. Meter Ltd., 6% Cum. Pf.	1	7/16— 9/16
120,000	1	9⅜d.	Bell's Asbestos Co., Ltd.	1	¾— ⅞
100,000	5	4/-	British Insulated & Helsby Cables Ltd., Ord. ..	5	5¾— 6¼
100,000	5	3/-	Do. 6% Cum. Pref.	5	5¼—5¾
£500,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Rd.	100	101 —104
£200,000	Stk	4½%	British Thomson-Houston Co., Ltd., 4½% 1st Mort. Deb. Stk. Red...	100	99 —101*
400,000	5	3/-	British Westinghouse Electric and Manufac. Co., Ltd., 8% Pref...	5	3¼— 3½
£616,353	Stk	4%	Do. 4% Mort. Deb. Stk. Red...	100	89 — 91
105,731	2	2/-	Brush Elec. Enging. Co., Ltd., Ord..	2	½— ¾
150,000	2	2/4⅘	Do. 6% Pref.	2	1½— 1¾
£125,000	Stk	4½%	Do. 4½% Perp. 1st Deb. Stk...	100	92— 95*
£125,000	Stk	4½%	Do. 4½% Perp. 2nd Deb. Stk.	100	79 — 82
35,000	5	5/-	Callender's Cable & Constn. Ltd. Ord.	5	11 — 11½
40,000	5	2/6	Do. 5 % Cum. Pref.	5	5½— 5¾
£200,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Red.	100	105 —107
85,000	3	1/6	Crompton & Co., Ltd...	3	2⅛— 2⅜
£100,000	—	5%	Do. 5% 1st Mort. Reg. Debs.	100	95— 98
52,000	5	10/-	Dick, Kerr & Co., Ltd., Ord. ..	5	7¾— 8¼
61,000	5	8/-	Do. 6% Cum. Pref.	5	5⅞— 6⅜
£300 000	Stk	4½%	Do. 4½% Deb. Stock, Red. ..	100	105 —107
288,884	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	1⅛— 1⅜
£288,884	Stk	4%	Do. 1st Mort. 4% Iree. Deb. Stk.	100	106 —109
99,261	5	1/6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	3	¾— 1
17,139	5	2/6	Do. "A" Shares Nos. 01-017,139	5	1 — 1½
£344,028	Stk	4%	Do. 4% Deb. Stock Red. ..	100	77 — 82
£100,000	Stk	5%	Do. 5% Second Deb. Stk. Red.	100	81 — 86
112,100	2	1/7½	Electric Construction Co., Ltd. ..	2	1⅛— 1¼
81,390	2	2/9⅗	Do. 7% Cumulative Pref. ..	2	2¼— 2½
£200,000	Stk	4%	Do. 4% Perp. 1st Mt. Deb. Stk.	100	97 — 99
10,248	10	7/6	Evered and Co., Ltd...	10	13 — 15
£100,000	Stk	5%	Ferranti, Ltd., 5% 1st Mort. Deb. Stock, Red...	100	90 — 95
25,000	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9½— 10
£200,000	Stk	4%	Do. 4% 1st. Mt. Deb. Stk., Red.	100	91 — 96
85,000	5	5/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	13 —13½
85,000	5	2/3	Do. 4½% Cum. Pref... ..	5	5⅜— 5⅝*
£50 000	Stk	4½%	Do. 4½% Mt. Deb. Stk. Red.	100	109—111*
50,000	10	5/-	India Rubber, Gutta Percha & Telegraph Works Co., Ltd.,	10	16 — 17
£300,000	100	4%	Do. 1st Mort. Deb. Red. ..	100	100 —103
7,500	10	—	Parker, Thos., Ltd.	10	6½— 7
100,000	1	3%	Scott (Ernest) & Mountain, Ld., Ord.	1	16/—16/6
37,350	12	12/-	Telegraph Construction and Maintenance Co., Ltd.	12	35 — 37
£150,000	100	4%	Do. 4% Deb. Bonds	100	102 —104

III.—ELECTRIC TRACTION.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
120,000	5	3/-	Anglo-Argentine Trams Co., Ld., Or.	5	8⅜— 8⅝
260,007	5	2/6	Do. 5% Cum Pf.	5	5⅝— 5⅞
£230,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888 ..	100	140 —143
20,000	10	6/-	Barcelona Trams Co., Ltd., Ord. ..	10	12 — 12½
10,000	10	5/-	Do. 5% Cum Pf. Shares	10	9 -- 10
£46,300	100	5%	Do. 5% Debs., Red. ..	100	99 --102
£191,326	Stk	4½%	Do. 4½% Red. Deb. Stk.	100	96 —100
75,606	1	—	Bath Elec. Trams. Ld., Pf. Or. ..	1	¾ — ⅞
59,294	1	11·49d	Do. 5% Cum. Pf. ..	1	15/16— 1 1/16
75,000	5	—	Brisbane Electric Tram Investment Co., Ltd., Ord... ..	5	1¼— 1¾
75,000	5	2/6	Do. 5% Cum. Pf. ..	5	3¾— 4¼
£425,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	94 — 98
£200,000	Stk	6%	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	103 —106
		%	Pref. Ord. Stock	100	100 —103
133,801	10	6/-	Brit. Electric Traction, Ltd., Ord.	10	9¼— 9¾
156,487	10	6/-	Do. 6% Cum. Pref.	10	10⅞—11⅛
£1,000,000	Stk	5%	Do. 5% Perp. Deb. Stk. ..	100	121 --123
£250,000	Stk	4½%	Do. 4% 2nd Deb. Stk. Red..	100	97 — 99
100,000	5	1/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	3¾— 4
40,500	5	3/-	Do. "A" 6% Cum Pref. ..	5	5⅝— 5⅞
27,000	5	3/-	Do. "B" do.	5	5¼— 5½

ELECTRIC TRACTION.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£200,000	Stk	5%	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	95 — 98
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	103—106
102,268	5	3/-	Calcutta Tramways Co., Ltd. ..	5	8⅝— 8
£350,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	106 —108
480,000	1	6d.	Cape Electric Tramways, Ltd. ..	1	1¼— 1
40,000	5	2/6	City of Birmingham Trams Co., Ltd. 5 % Cum. Pref.	5	4⅞— 5
£300,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	101 —104
£120,000	Stk	5%	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	101 —104
60,000	10	6/-	Dublin United Trams. Co. (1896), Ltd., Ord. ..	10	13 — 14
59,987	10	6/-	Do. 6% Pref...	10	15½— 16½
30,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	3 — 3½*
£150,000	Stk	4%	Do. 4% Deb. Stock.. ..	100	89 — 92
125,000	10	5/-	London United Trams. (1901), Ltd., 5% Cum. Pref.	10	10 —10½
£1,031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	103 —105
£50,000	Stk	5%	Madras Electric Trams (1904), Ltd., 5% Deb. Stock, Red.	100	101 —103
314,016	1	—	Metropolitan Elec. Trams, Ltd., Def.	1	[illegible]
500,000	1	6d.	Do. 5% Cum. Pref... ..	1	15/16— 1
£350,000	Stk	4½%	Do. 4½% Deb. Stock, Red.	100	105 —107
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	½— 1½
110,923	8	3/2⅘	North Metropolitan Tramways Co..	8	4 — 4½
£150,000	100	3½%	Do. 3½% Mort. Debs.	100	90 — 95
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red..	100	104 —107
24,500	10	10/-	Potteries Elec. Traction Co., Ld., Or.	10	9 — 9½
24,500	10	5/-	Do. 5% Cum. Pref. ..	10	8½— 9½
£220,000	Stk	4½%	Do. 4½% Deb. Stk., Red.	100	102 —105

IV.—ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
7,500	10	16/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. ..	10	12½— 1
7,500	10	4/6	Do. 4½% Cum. Pref. ..	10	9½— 10
7,500	10	6/-	Do. 6% Cum. Second Pf. ..	10	11 — 12
£70,000	Stk	4½%	Do. 4½% Deb. Stock Red ..	100	104 —106
14,000	5	2/-	Bromley (Kent) Elec. Lt. & Pr. Co. Ld	5	5¼— 5
£50,000	Stk	4½%	Do. do. 4½% 1st Deb. Stk. Red.	100	101 —104
27,507	5	4/6	Brompton & Kensington Elec. Supply Co., Ltd. Ord. ..	5	10¾— 11
12,493	5	3/6	Do. 7% Cum. Pref. Shares..	5	10¼— 10
60,000	5	3/-	Calcutta Elec. Sup. Cor. Ltd., Ord..	5	9 — 9¼
£288,782	Stk	4%	Central Elec. Sup. Co., Ltd., 4% Gua. Deb. Stk. ..	100	105 — 10
70,000	5	4/-	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord... ..	5	7½— 8
80,000	5	2/3	Do. do. 4½% Cum. Pref...	5	5½— 5
£350,000	Stk	4%	Do. do. 4% Deb. Stk. Red.	100	102 —104
41,436	5	3/9	Chelsea Elec. Sply. Co., Ltd., Ord.	5	6¾— 7¼
£150,000	Stk	4½%	Do. do. 4½% Deb. Stk., Red	100	109 —111
70,595	10	5/-	City of London El. Lghtg. Co., Ld., O.	10	12¾— 13
40,000	10	6/-	Do. 6% Cum. Pref.	10	13¾— 14
£400,000	Stk	5%	Do. 5% Deb. Stk., Red ..	100	123 —127
£300,000	Stk	4½%	Do. 4½% 2nd Deb. Stk., Red	100	103 —105
40,000	10	4/-	County of London Elec. Supply Co., Ltd., Ord.	10	9½— 10
30,000	10	6/-	Do. 6% Cum. Pref.	10	12½— 12
£400,000	Stk	4½%	Do. 4½% Deb. Stk., Red. ..	100	109 —112
70,000	5	2/6	Edmundson's Elec. Cor. Ltd., Ord.	5	6¼— 6
70,000	5	3/-	Do. 6% Cum. Pref.	5	6 — 6
£300,000	Stk	4½%	Do. 4½% 1st Mort. Db. Stk. Reg	100	106 —108
£80,000	Stk	5%	Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. Stk. Red.	100	86 — 91
10,000	5	2/-	Folkestone Elec. Supply Co., Ld., O.	5	5½— 6
£50,000	Stk.	4½%	Do. 4½% 1st Deb. Stk., Red.	100	101 —104
15,000	10	—	Havana Electricity Co., Ltd... ..	10	9¾—10½
13,000	5	3/6	Hove Elec. Lighting Co., Ltd., Ord.	5	7½— 8
£50,000	Stk	4½%	Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock, Red.	100	101—103
150,000	1	—	Kalgoorlie Electric Power & Lighting Corp, Ltd., 6% Cum. Pref.	1	½—
21,000	5	7/-	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord. ..	5	12¾— 13½

Stocks and Shares marked * are quoted ex-dividend.

ELECTRIC LIGHTING AND POWER.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£135,000	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	102 —104
111,000	3	1/9⅗	London Elec. Supply Corp., Ld., Ord.	3	2 9/16 — 2 13/16*
60,000	5	3/-	Do. 6% Pref.	5	5½ — 6½*
£371,895	Stk	4%	Do. 4% 1st Mort. Db. Stk., Red.	100	99 —101
100,000	10	9/-	Metropolitan Elec. Sup. Co., Ld., Or.	10	18¾— 19¼
76,121	5	2/3	Do. 4½% Cum. Pref.	5	5⅝ — 5¾
220,000	Stk	4½%	Do. 4½% 1st Mort. Db. Sk., Red.	100	110 —115
250,000	Stk	3½%	Do. 3½% Mort. Deb. Stk., Red.	100	97 — 99
£250,000	—	4½%	Midland Elec. Corp. for Power Distribution, Ld., 4½% 1st Mort. Deb.	100	97 —100
10,852	10	6/-	Notting Hill Elec. Ltg. Co. Ltd. Ord.	10	14½— 15
£59,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	102 —104
16,500	5	2/6	Oxford Electric Co. Ltd., Ord. ..	5	6¼— 6½
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	98 —100
£84,700	100	4½%	Royal Elec. Co. (of Montreal) 4½% 20-yr. 1st Mort. Deb	100	100 —102
40,000	5	9/6	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	13½— 14*
20,000	5	3/6	Do. 7% Pref...	5	8¼—8¾*
£150,000	Stk	3½%	Do. 3½% Deben. Stock, Red	100	98 —100
12,000	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2⅝— 3⅛*
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	79 — 83
65,000	5	3/-	South London Elec. Sup. Co., Ltd. O.	5	4⅛— 4⅜
100,000	1	—	South Metropolitan Elec Light & Power Co., Ltd. Ord.	1	⅞ — 1
50,000	1	8⅖d.	Do. 7% Cum. Pref.	1	1⅜— 1 7/16
£100,000	Stk	4½%	Do. 4½% 1st Deb. Stock Red.	100	107 —110
50,000	5	2/6	Urban Electric Supply Co., Ltd., O.	5	5 1/16 —5 3/16
30,000	5	2/6	Do. 5% Cum Pref.	5	5⅛— 5¼
£200,000	Stk	—	Do. 4½% 1st Mort. Deb. Stk. Red	100	106 —108
110,000	5	7/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	12¾ —13¼*
28,151	5	2/6	Do. 5% Cum. Pref.	5	6¼— 6¾

V.—TELEGRAPH & TELEPHONE COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£34,800	100	4%	African Direct Tel. Co., Ld., 4% Mt. Debs. (Series A), Red.	100	99 —102
25,000	10	—	Amazon Telegraph Co., Ld... ..	10	2¼ — 2¾
£763,580	Stk	17/6	Anglo-American Tel. Co., Ltd., Ord.	100	60 — 62
£3,118,210	Stk	35/-	Do. 6% Preferred Ordinary	100	107 —109
£3,118,210	Stk	2/-	Do. Deferred Ordinary ..	100	15¼—15½
44,000	5	3/-	Chili Telephone Co., Ltd.	5	6⅜— 6½
$15,000,000	$100	$2	Commercial Cable Co., Capital Stk.	$100	230 —240
£1,903,856	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	97 — 99
16,000	10	5/-	Cuba Submarine Tel. Co., Ld., Ord.	10	8¾— 9¼
6,000	10	10/-	Do. 10% Preference	10	17 — 18
6,000	5	2/-	Direct Spanish Telegraph Co., Ord.	5	3⅜— 3⅝
		5/-	10% Cum. Preference	5	8 — 8½
£30,000	50	4½%	Do. 4½% Debs...	50	100-102%
60,710	20	3/-	Direct U.S. Cable Co., Ltd... ..	20	11 —11½
£85,800	100	4½%	Direct West India Cable Co., Ltd., 4½% Reg. Debs.	100	99 —101
£300,000	100	4%	East. & S. African, Ld., 4% Mt. Dbs.	100	100—102
£200,000	25	4%	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)..	25	101-103%
800,000	10	2/6	Eastern Extension, Australasia and China, Ltd...	10	14 — 14½
£602,400	Stk	4%	Do. 4% Mort. Deb. Stk., Perp.	100	104 —106
£4,000,000	Stk	25/-	Eastern Tele. Co., Ltd., Ord. ..	100	143 —146
£2,000,000	Stk	17/6	Do. 3 % Pref.	100	90 — 92
£1,836,814	Stk	4%	Do. 4% Mort. Deb.	100	106 —108
150,000	10	5/-	Great Northern Telegraph Co., Ltd., (of Copenhagen) ..	10	32 — 33
£58,700	100	4½%	Halifax and Bermudas Cable Co., Ltd., 4½% 1st. Mort. Debs. Red.	100	100—102
17,000	25	12/6	Indo-European Tele. Co., Ltd. ..	25	46 — 48
72,680	1	7⅕d.	Monte Video Telephone Co., Ltd., O.	1	13/16— 15/16
£1,983,333	Stk	6%	National Telephone Co., Ltd., Pref.	100	112—113
£1,966,667	Stk	5%	Do. Deferred	100	106—108
250,000	5	2/6	Do. 5% Non-Cum. 3rd Pref.	5	5½ — 5¾
£2,000,000	Stk	3½%	Do. 3½% Deb. Stk., Red. ..	100	98 —100
£689,593	Stk	4%	Do. 4% do. do. ..	100	104 —106
179,313	1	7⅕d.	Oriental Telephone & Elec. Co., Ltd.	1	1¼ — 1⅜
50,000	1	7⅕d.	Do. 6% Cum. Pref.	1	1 3/16 — 1 5/16
£100,000	100	4%	Pacific & European Tel. 4% Guar. Debs. Red...	100	98 —101
11,839	8	4/-	Reuter's Telegram Co., Ltd. ..	8	7¼— 7¾
58,000	5	3/-	United River Plate Telep. Co., Ltd.	5	7¼— 7¾
40,000	5	2/6	Do. 5% Cum. Pref.	5	5 — 5¼
£179,947	Stk	5%	Do. 5% Deb. Stock, Red. ..	100	106—108
15,600	10	4/-	W. African Telegraph Co., Ltd. ..	10	8 — 8½
£30,008	2½	—	West Coast of America, Ltd. ..	2½	5/16 — 7/16
150,000	100	4%	Do. 4% Deb. Guar. by West. Tel.	100	100 — 102

TELEGRAPHS AND TELEPHONES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name	Paid up.	Closing Prices.
88,341	10	6d.	W. India & Panama Teleg. Co., Ld., Or.	10	⅞ — 1
34,563	10	6/-	Do. 6% Cum. 1st. Pref. ..	10	8½ — 9
4,669	10	6/-	Do. 6% Cum. 2nd Pref. ..	10	8¼ - 8¾
£80,000	100	5%	Do. 5% Deb.	100	102 —104
207,930	10	3/-	Western Telegraph Co., Ltd. ..	10	13½— 14
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	101 —103
518,915	Stk	4%	Do. 4% Deb. Stock, Red. ..	100	102 —104

VI.—SHIPPING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
32,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 5½% Cum. Pref.	10	8½— 9
£325,000	Stk	4½%	Do. 4½% Red. 1st Mort. Deb. Stk.	100	99 —101
£672,900	Stk	4½%	British & African Stm. Nav. (1900) Ltd., 4½% 1st Mort. Deb. Stk., Red.	100	93 — 95
40,000	10	5/6	Bucknall Steamship Lines, Ltd., 5½% Cum. Pref.	10	6 — 6½
£600,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk.	100	74 — 77
£750,000	Stk	4½%	Clan Line Steamers, Ltd., 4½% Deb. Stk. Red. ..	100	98 —100
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000..	20	13½ - 14
40,000	20	8/-	Do. Nos. 60,001-100,000	10	5½— 6
£461,430	Stk	4½%	Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. ..	100	101 —103
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord...	1	1 1/16—1 3/16
25,328	7½	4/7	Gen. Steam Navigation Co., Ld., Ord.	7½	4¼— 4¾
36,758	8	4/9⅗	Do. Non-Cum. 6% Pref.	8	7½— 8
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	99 —101
55,000	5	1/3	Houlder Line, Ltd., Ord.	5	2½— 3
40,000	5	2/9	Do. 5½% Cum. Pref.	5	3¼— 3¾
£200,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk. Red.	100	83 — 86
141,500	10	5/-	Leyland (Fredk.), & Co., (1900), Ltd., 5% Cum. Pref. ..	10	5¼ 5¾
£1,160,000	Stk	5 %	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. ..	100	131 —134
£1,160,000	Stk	19%	Do. do. Deferred ..	100	224 —227
15,000	100	30/-	Royal Mail Steam Packet Co. Ord..	60	25½ — 26½
39,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref..	5	4¾— 5¼
39,075	5	2/6	Do. "B" Ord...	5	4 — 4½
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord..	10	8¼— 8¾
24,000	10	4/6	Do. 4½% Cum. Pref... ..	10	9¾— 10¼
£1,008,894	Stk	4%	Do. 4% Debenture Stk., Red.	100	99 —101

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
60,000	1	9⅗d.	Chadburn's (Ship) Tele. Ltd., Ord...	1	⅞— 1⅛
£750,000	Stk	5%	General Hydraulic Power Co., Ltd.	100	133 —138
12,500	10	10/-	Oakey (John) and Sons, Ltd., Ord..	10	24 — 26
10,000	10	6/-	Do. do. 6% Cum. Pf.	10	14 — 15
183,538	1	6·3d.	Power Gas Corp., Ltd., Ord., Nos. 66,463-250	15/-	5/16— 7/16
66,462	1	8·4d.	Do. do. Nos. 1 66,462	1	9/16— 11/16
135,000	1	6d.	Waygood (R.) & Co., Ltd., Ord. ..	1	1 1/16— 1 3/16
135,000	1	7⅕d.	Do. 6% Cum. Pref. ...	1	1⅛— 1¼

RAILWAY CARRIAGE & WAGON COMPANIES.

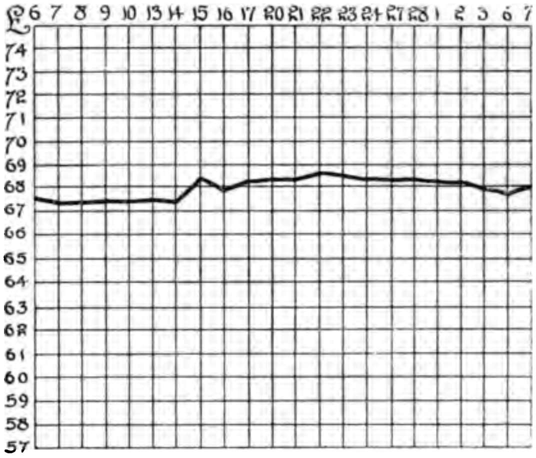
Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
10,000	10	7/6	Birm. Railway-Car. & Wagon, L., 1-10,000	10	21 —22*
8,739	10	3/-	Do. Second Issue 1-8,739....	4	8¾— 9*
10,000	10	6/-	Do. Cum. Pref. 6% 1-10,000..	10	13 —13¼*
30,111	7	7/-	Gloucester Rail.-Car & Wagon, Ld., A, 1-29,861 & 49,751-50,000	7	9 — 9½
44,889	7	3/6	Do. B, 29,862-49,750, 50,001-75,000	7	4 — 4½
14,567	10	1/3	Lancashire Wagon, Ord.	2	2 3/16— 5/16
4,150	10	5%	Do. do.	10	10¼—10¾
781,808	1	9d.	Metropolitan Amalgamated Rail.-Carriage & Wagon, Ld., 1-784,808	1	41/3—42/
164,288	1	6d.	Do. Cum. A Pref. 5% 1-164,288	1	23/6—24/6
235,000	1	7⅕d.	Do. Cum. B Pref. 6% 1-235,000	1	28/—28/6
20,000	20	20/-	Midland Rail.-Car. & Wagon, Ld., 1-20,000	10	19 —19¼

Stocks and Shares marked * are quoted ex-dividend.

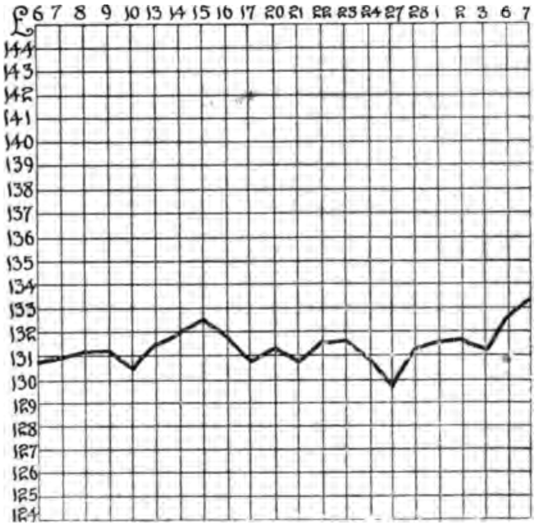
THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM FEBRUARY 6TH TO MARCH 7TH, 1905.

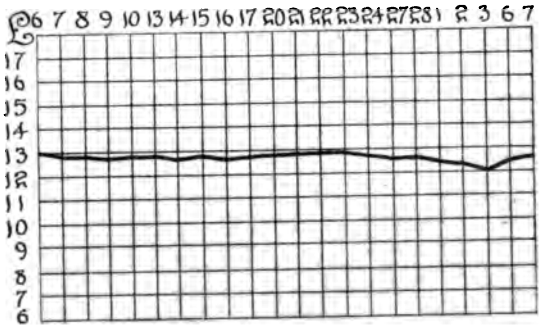
COPPER.



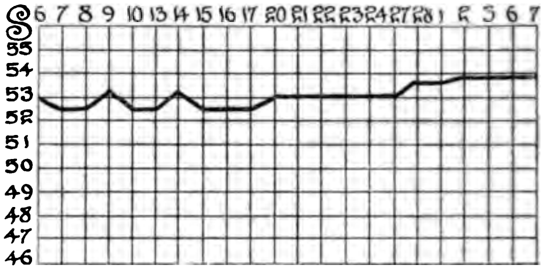
TIN.



ENGLISH LEAD.



PIG IRON: SCOTCH,



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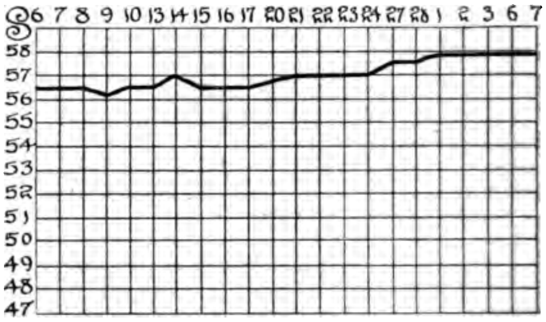
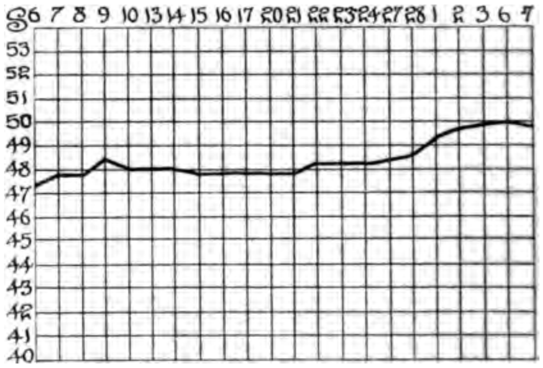
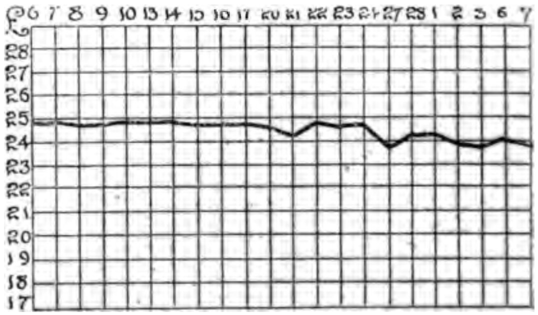


CLEVELAND.



SPELTER.



PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

MARKET REPORT.

Wednesday, March 8th, 1905.

THE home Copper market has been somewhat inactive during the past week, notwithstanding satisfactory American advices. However, the demand for refined copper remains on a fairly satisfactory scale, and stocks in consumers' hands are very low, a significant feature being the call for immediate delivery. The latest turn in the market is towards a partial recovery, the closing prices yesterday being cash £68 2s. 6d. and three months £68 7s. 6d.

Dealings in Tin have been on a large scale. The statistics published at the end of the month were exceedingly satisfactory, there being a decrease of 3,145 tons in the total visible supplies in Europe, although stocks in the United States are said to be about 1,800 tons higher. Some excitement has been created in the market by the announcement that the Dutch sales, for the remainder of he year, would be curtailed, and the market has risen sharply to £133 15s. cash, and £132 10s. three months.

Holders of Lead have again been obliged to make sacrificing sales, as low as £12 being accepted for prompt delivery, and the quotation remains about this figure, closing prices being £12 foreign, and £12 5s. English.

In the Iron and Steel section very strong advices from the United States have dominated the situation. The output of pig-iron and the demand for it are said to be unprecedented, and there are all the makings of a genuine boom about the present position. The market for Cleveland warrants has been very strong, the aggregate business totalling about 90,000 tons, and quotations show an important rise, large buying orders from consumers and speculators being accompanied by bear covering. Merton and Co's circular points out that makers of Cleveland iron are well sold owing to their large deliveries into public stores, and the same authority is responsible for the statement that the position has in it elements of sensationalism, and that the current production in the United States, notwithstanding that it is the largest on record, will be insufficient to meet the country's requirements.

A sharp reaction in Spelter brought the price down to £23 15s., but a steadier tendency is now noticeable and consumers are now buying more readily.

IRON, STEEL, PIG-IRON, &c.

SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as follows. Prices delivered in Glasgow or equal:—

	£	s.	d.
Steel:			
Siemens' Steel Plates, Marine Boiler Quality	6	15	0
,, ,, ,, Land ,, ,,	6	17	6
,, ,, ,, Ship Quality Plates	5	17	6
Siemens' Steel Bars, Boiler Quality	6	17	6
,, ,, ,, Ship ,,	6	7	6
,, ,, Angles	5	7	6
Manufactured Iron:			
Bars—Dalzell	6	2	6
,, Best	6	12	6
,, ,, Horseshoe	6	12	6
,, Angle	6	2	6
,, Best Angle	6	12	6
,, Best Best	7	2	6
,, Extra Best	7	12	6

Usual terms and extras. Special rates for delivery in England and export. The above prices subject to alteration without notice.

The Glasgow Iron and Steel Co., Ltd., Wishaw, quote as under (prices are delivered Glasgow or equal):—

	£	s.	d.	
Steel Angles (Glasgow ♕ Steel)	5	7	6	per ton.
Steel Ship Plates (Glasgow ♕ Steel)	5	17	6	,,
Steel Bars, Ship Quality (Glasgow ♕ Steel)	6	7	6	,,
Steel Bars, Boiler Quality (Glasgow ♛ ♛ Steel)	6	17	6	,,
Steel Land Boiler Plates (Glasgow ♛ ♛ Steel)	6	7	6	,,
Steel Marine Boiler Plates (Glasgow ♛ ♛ Steel)	6	7	6	,,

Less 5 per cent. discount. Extras as per standard list.

Special prices for delivery in England and for export. The above prices subject to alteration without notice.

John Spencer (Coatbridge), Ltd., Phœnix Ironworks, Coatbridge, N.B., quotes:—

	£	s.	d.
Bars—Phœnix	6	5	0
,, Best	6	15	0
,, Best Best	7	5	0
,, Extra Best	7	15	0
,, Best Horse Shoe	6	15	0
,, Extra B.H.S.	7	15	0
,, Extra Best Cable	8	5	0
,, Rivet	6	5	0
,, Best Scrap Rivet	7	5	0

	£	s.	d.
Angles—Phœnix	6	5	0
,, Best	6	15	0
,, Extra Best	7	5	0
Gas Tube Hoops—Phœnix Best	6	15	0
Plates—Phœnix	—		
,, Best Boiler	7	10	0
,, Best Best Boiler	8	0	0
,, Extra Best Boiler	9	0	0
Boiler Tube Strips—Phœnix Best Best	8	0	0

All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly.

Messrs. R. Feldtmann and Co., of Glasgow, quote Commission extra).

Pig Iron:

	No. 1. £	s.	d.	No. 3. £	s.	d.
Coltness, f.a.s. Glasgow	3	4	6	2	14	0
Gartsherrie ,,	2	19	0	2	14	0
Summerlee ,,	2	19	0	2	14	0
Carnbroe ,,	2	16	6	2	12	6
Langloan ,,	3	4	0	2	15	0
Calder ,,	2	19	0	—		
Clyde ,,	2	18	6	2	13	6
Glengarnock, f.o.b. Ardrossan	2	18	0	2	12	6
Eglinton ,, ,,	2	14	6	2	12	6
Dalmellington, ,, Ayr	2	14	6	2	12	6
Shotts ,, Leith	2	19	0	2	14	6

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, **at works:—**

	£	s.	d.
W.W. ♛ Bars	6	12	6
W.W. Best Bars	7	2	6
W.W. Best Best	7	12	6
W.W. Best Best Best	8	2	6
W.W. Best Shoe	7	2	6
Thornaby ♛	8	2	6
Thornaby Best	8	12	6
Thornaby Best Best	9	12	6
Whitwell Special Admiralty Cable	10	5	0
Special Chain Iron	9	5	0
Tube and Nail Strips	6	15	0
W.W. ♛ Angle Iron	6	15	0
W.W. Best Angle Iron	7	5	0
Tee Iron, to 8-inches United	7	12	6

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington, quote:—

		Iron. £	s	d.	Steel. £	s.	d.
♛ (BKF)	Bars	6	10	0	7	5	0
	Angles	7	0	0	7	5	0
	Tees	7	10	0	7	15	0
♛ W.I.W	Hoops	7	0	0	7	10	0
	Sheets	7	10	0	8	0	0

Ordinary Sizes, F.A.S. Liverpool in 10-ton Lots.
Extras for Sizes and Cutting as per List.

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

Black Sheets:	Singles 20 G 96in. by 36in. per ton. £	s.	d.	Doubles 21 G to 24 G 96in. by 36in. per ton. £	s.	d.
"Vale"	10	0	0	10	10	0
"Shield"	10	10	0	11	10	0
"Severn"	11	10	0	12	10	0
"Baldwin Wilden B."	12	10	0	13	10	0
Charcoal	16	10	0	17	10	0
Best Charcoal	18	10	0	19	10	0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:

	£	s.	d.	£	s.	d.
No. 3 Lead	13	10	0	14	10	0
S.V. Lead	15	0	0	16	0	0
No. 3 Terne	15	0	0	16	0	0
S.V. Terne	16	10	0	17	10	0

Tinned Sheets:	Singles 20 G to 108 by 36in. per ton. £	s.	d.	Doubles 21 to 24 G to 96 by 36in. per ton. £	s.	d.
Best Coke (Finish)	28	0	0	29	10	0
,, Charcoal (Finish)	30	0	0	31	10	0
Extra ,, ,,	32	0	0	33	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.

Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box.

Extreme sizes in Tin and Patent Coated specially quoted for.

Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.

At works less 2½% for cash monthly, 10th inst.

Galvanized Corrugated Sheets:

	£	s.	d.	
"Phœnix" Brand, 24 G., f.o.b. London, in Bundles	11	15	0	per ton.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	14	7	6	,,

Galvanized Working Up-Sheets:

	£	s.	d.	
24 G., f.o.b. London, in Bundles	13	15	0	per ton.

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£	s.	d.	
Crown Bars	6	10	0	per ton.
Best Bars (1 to 6in. wide, above ¼ in. thick, ½ in. to 4 rounds and squares)	7	0	0	,,
Angles	6	15	0	,,
,, Best	7	5	0	,,
T's	7	0	0	,,
,, Best	7	10	0	,,
Best Shoe Iron	8	0	0	,,
,, Rivet Iron	8	0	0	,,
,, Best Rivet (Special)	9	5	0	,,
,, Cable	9	5	0	,,
,, Screwing	8	5	0	,,

	£	s.	d.	
Best Turning	8	0	0	per ton.
,, Plating	8	5	0	,,
Best Best	9	5	0	,,
Treble Best	10	5	0	,,
Plates	7	10	0	,,
Best Plates	8	0	0	,,
,, Boiler Plates	8	10	0	,,
,, Best Boiler Plates	9	10	0	,,
Treble Best Boiler Plates	12	0	0	,,

Delivery f.o.b. Liverpool, Birkenhead or Manchester.

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon., quote "Star" brand patent wrought nails, steel nails, &c.

Discounts—

45 per cent. off 1-inch to 3-inch strong rose and all fine rose and 6dy. and 8dy. pound.

40 per cent. off 3½ inch to 7-inch strong rose and 10dy. and 20dy. pound.

40 per cent. off all sharp-pointed nails.

Delivered in lots of 4 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis:—
2 tons 9/6 per cwt. } d/d any Railway Station.
4 cwt. lots and upwards 9/9 per cwt. }

Steel cut nails, 3-inch basis—
2 tons 8/3 per cwt. } d/d any Railway Station.
4 cwt. lots 8/6 per cwt. }
Slit rods (iron) £7 10s. per ton, at works for 2-ton lots.

Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E. C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla, quote:—

	Per Box. f.o.b. Wales. £	s.	d.
Coke Tin-plates.			
C 18¾ by 14 124s. 110 lb. "BV"	0	12	4½
C 20 by 10 225s. 155 ,, "Jumbo"	0	17	6
C 20 by 14 112s. 108 ,, "Lydbrook"	0	12	1½
C 28 by 20 112s. 216 ,, "Lydbrook"	1	4	6
Charcoal Tinplates:			
C 20 by 14 112s. 108 lb. "Allaway"	0	12	10½

BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes:—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

		£	s.	d	
Steel:					
Blooms	at	3	12	0	per ton.
Billets	at	3	14	0	,,
Sheet Bars	at	3	16	0	,,
Finished Steel:					
Bars	at	5	0	0	per ton.
Angles	at	5	1	0	,,
Tees	at	5	4	0	,,
Joists	at	4	10	0	,,
Fencing Standards	at	5	2	0	,,
Shoeing Bars	at	5	4	0	,,
Tyre Bars	at	5	4	0	,,
Half-Round Bars	at	5	5	0	,,
Heavy Rails	at	4	15	0	,,
Light Rails	at	4	17	6	,,

Structural Steelwork:

Prices on application.

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote:—

TIN.

Tin:	£	s.	d.		£	s.	d.	
English Ingots, f.o.b. Dis. 1½% & 1%	133	0	0	to	133	10	0	per ton.
English Bars, f.o.b. Dis. 1½% & 1%	134	0	0	to	134	10	0	,,
Straits G.M.B., cash Warehouse, Net	133	5	0	to	133	7	6	,,
Straits G.M.B., 3 months, Warehouse, Net	132	2	6	to	132	5	0	,,
Australian, Mt. Bischoff, Warehouse, Net	133	5	0	to	134	5	0	,,

COPPER.

Copper:	£	s.	d.		£	s.	d.	
Standard G.M.B., cash Warehouse, Net	67	15	0	to	67	17	6	per ton.
Standard G.M.B., 3 months, Warehouse, Net	68	2	6	to	68	5	0	,,
English, Tough, Cake & Ingot, Warehouses, Net	70	15	0	to	71	5	0	,,
English, Best Select, Warehouse Net	71	15	0	to	72	5	0	,,
English, Sheets and Sheathing, f.o.b., Dis. 2½%	80	0	0	to	80	10	0	,,
English, Sheets for India, f.o.b., Dis. 2½%	76	0	0	to	76	10	0	,,
Electro, Warehouse, Net	70	15	0	to	71	0	0	,,
Ore, ex. ship	0	12	0	to	0	13	0	per unit.
Regulus, Matte and Precipitate, ex. ship,	0	13	3	to	0	14	0	,,

YELLOW METAL.

Yellow Metal:	£	s.	d.	£	s.	d.	
Sheets, 4 by 4 feet for India f.o.b. Dis. 2½%				0	0	6¾	per lb.
Sheathing ,, ,,				0	0	6⅞	,,

SPELTER.

	£	s.	d.		£	s.	d.	
Silesian outports, Net	23	15	0	to	24	0	0	per ton
Blende of 50% Net	6	11	6	to	6	15	0	,,
Calamine, Net	6	14	0	to	6	15	0	,,

LEAD.

	£	s.	d.		£	s.	d.	
English Pig, Warehouse, Dis. 2½%	12	5	0	to	12	10	0	per ton.
Spanish, ex ship, Dis. 2½%	12	0	0	to	12	2	6	,,
Lead Ore of 70%, Net	6	2	6	to	--			,,

ANTIMONY.

	£	s.	d.		£	s.	d.	
Star Regulus, f.o.b., Dis. 2½%	36	0	0	to	36	10	0	per ton.
Ore, 50%, ex ship, Dis. 2½%	8	10	0	to	9	10	0	,,
Crude, ex ship, Dis. 2½%	13	10	0	to	14	0	0	,,

QUICKSILVER.

	£	s.	d.	
Spanish, 75 lb., Warehouse, Net	7	12	6	per flask.
Italian ,, ,, ,,	7	11	6	,,

COAL.

LEICESTERSHIRE.

The Nailstone Colliery Company, Leicester, quote. Price per Ton at Pit of 20 Cwt., with ½ Cwt. per Ton for wastage —

Upper Main Seam.	s.	d.
Main Coal	7	6
Best Hard Steam (hand picked, as used by the Railway Companies)	6	0
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)	6	0
Fine Slack	0	6

Terms, net cash on 10th of month following delivery.

DERBYSHIRE.

The Manners Colliery Co., Ltd., of Ilkeston quote as follows, per ton at pit:

Kilburn Coal:	s.	d.
Best London Brights	9	9
Large Nuts (1½ to 3½)	9	6
Small Nuts (¾ to 1½)	6	0
Rough Brights	6	0
Peas (⅜ to ¾)	5	0
Slack	3	6
Smudge	2	0

Low Main (or Tupton) Coal:		
Low Main Brights	7	6
,, ,, Nuts	7	3
Hards (Good Steam Coal)	8	0
Bakers' Nuts (1" to 2")	6	6
Slack	3	6

The Clay Cross Company's Collieries, Clay Cross, near Chesterfield, quote:—

	per ton at pit. s.	 d.
Best Main Coal	10	6
Best Silkstone	10	0
Best House Coal	8	6
Best House Nuts	8	0
Treble Screened Cobbles	7	9
Best Cobbles	7	3

NOTTINGHAMSHIRE.

The Digby Colliery Co., Ltd., near Nottingham, quote per ton at pit:—

Digby Coal:

STEAM.	s.	d.
Best Hand Picked Hard	9	0
Steam Hard	7	9
Hard Nuts	7	0

Gedling Colliery.

HIGH HAZEL.		
London Brights, 4 to 8 in. cube	12	0
Large Nuts, 2 to 4 in. cube	9	6
Small Nuts, ¾ to 2 in. cube	5	6

STEAM.—TOP HARD.		
Hard	9	0
team	8	0
s	7	0

CHEMICALS AND OILS.

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square, Manchester, quote:

	£	s.	d.	
Acids: Oxalic	0	0	2½	per lb.
Picric, Crystals	0	0	11	,,
Tartaric .... at Manchester	0	0	10⅜	,,

	£	s.	d.	
Acetate of Lime: Brown at Manchester net	9	10	0	per ton.
Grey ,,	11	10	0	,,
Alumina: Alum, Lump, loose	5	5	0	,,
,, ,, in casks	5	7	6	,,
,, Ground, in bags	5	15	0	,,
Sulphate of Alumina, 14%	4	10	0	,,
Ammonia: Carbonate	0	0	3⅜	per lb.
Muriate Grey f.o.b. Liverpool	24	0	0	per ton.
Sal-ammoniac, Lump, 1sts, del^d. U.K.	42	0	0	,,
,, ,, 2nds, ,,	40	0	0	,,
Sulphate .... f.o.b. Liverpool	13	2	6	,,
Arsenic: Best White Powdered ....net	12	5	0	,,
Bleaching Powder, 35% .... ,,	4	10	0	,,
Borax: British Refined Crystal......... ,,	12	0	0	,,

Coal Tar Products:				
Benzole, 50/90 % ,,	0	0	6	per gal.
,, 90% ,,	0	0	7	,,
Carbolic Acid Crystals, 34/35° C. ... ,,	0	0	6	per lb.
,, ,, ,, 39/40° C. ... ,,	0	0	6¼	,,
,, ,, Liquid, 97/99 % ... ,,	0	0	9	per gal.
,, ,, Crude, 62½ % at 60° F. f.o.b. ,,	0	1	9	,,
Creosote, ordinary good liquid ,,	0	0	1¼	,,
Naphtha, Crude, 20 % at 120° C.... ,,	0	0	3	,,
,, Solvent, 90% at 160° C. f.o.b ,,	0	0	8	,,
,, ,, 95 % at 160° C. ,, ,,	0	0	9	,,
,, ,, 90 % at 190° C. ,, ,,	0	0	10	,,
,, Rectified, flash point over 73° F. ....f.o.b. ,,	0	0	11	,,
,, Rectified, flash point over 100° F. ....f.o.b. ,,		1	0	,,
Naphthalene, all qualities.				
Pitch...............f.a.s. Manchester. ,,	1	11	6	per ton.
Copperas: Green, in bulk ,,	0	12	6	,,
,, barrels f.o.b. L'pool ,,	1	19	0	,,
Cake ,,	1	2	6	,,
Copper: Sulphate	22	15	0	,,
Cyanides: 98% minimum ......f.o.b. net	0	0	7½	per lb.
Lead: Acetate (Sugar) White. English	27	10	0	per ton.
,, ,, ,, Foreign c.i.f. U.K	24	5	0	,,
,, ,, Grey	21	15	0	,,
,, ,, Brown at Manchester	17	0	0	,,
Nitrate	24	0	0	,,
Litharge, Flake	15	10	0	,,
,, Powder	16	0	0	,,
Red Lead, Genuine, c.i.f. London less 5%	15	10	0	,,
White ,, ,, Dry ,, ,, ,,	16	15	0	,,
Naphtha (Wood): Miscible, 60 o.p.	0	2	10	per gal.
Solvent	0	2	7	,,
Potash: Bichromate... delivered England...	0	0	3	per lb.
Carbonate, 90/92 % ... c.i.f Hull ...	18	10	0	per ton.
Caustic, 75/80 % ...... ,, ,, ...	20	15	0	,,
Chlorate ....net	0	0	$3\frac{1}{16}$	per lb.
Montreal.........in Store, Liverpool	35	0	0	per ton.
Prussiate, Yellow ....net	0	0	5	per lb.

		£	s.	d.	
Soda:	Ash, Caustic, 48 %, Ordinary ... net	5	5	0	per ton.
	,, ,, ,, Refined...... ,,	6	5	0	,,
	,, Carbonated, 48 %........... ,,	5	10	0	,,
	,, ,, 58 % (Ammonia Alkali) ....net	4	10	0	,,
	,, Bleachers' Refined Caustic 50/52 % .... net	6	10	0	,,
	Caustic, White, 77 %.............. ,,	10	10	0	,,
	,, ,, 70 %.............. ,,	9	12	6	,,
	,, ,, 60 %.............. ,,	8	12	6	,,
	,, Cream, 60 %..... .... ,,	8	10	0	,,
	Crystals, in bags	3	0	0	,,
	,, barrels	3	7	6	,,
	Acetate .... c.i.f. Hull net	16	15	0	,,
	Bicarbonate, in 1 cwt. kegs...........	6	15	0	,,
	Bichromate......delivered England...	0	0	2¼	per lb.
	Chlorate .... net	0	0	3$\frac{1}{16}$	per lb.
	Nitrate...ex quay Liverpool, ... ,,	11	7	6	per ton.
	Phosphate	9	5	0	,,
	Prussiate ....net	0	0	3⅝	per lb.
	Silicate, Solution, 140° Tw.	4	10	0	per ton.
	Sulphate (Glauber Salts)...............	1	12	6	,,
	,, (Saltcake, 95%)..............	1	15	0	,,
Sulphur:	Recovered	4	15	0	,,
	Roll	6	15	0	,,
	Flowers..................................	7	10	0	,,
Zinc:	Sulphate	6	15	0	,,

MINERALS.

		£	s.	d.	
Barytes:	Lump Carbonate, 90/92%	3	10	0	per ton.
	Sulphate, No. 1, White	2	15	0	,,
China Clay:	of various qualities for all purposes; prices from about 11/- to about 30/- per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid.				
Chrome Ore:	Basis 50% c.i.f. British Ports..........	3	7	6	,,
Manganese:	Lump c.i.f. Liverpool 10¼d.	per metallic unit.			
Ochre:	French JC .... f.o.b. Rouen, net	2	5	0	per ton.
	,, JF	5	10	0	,,
Talc:	(French Chalk).........c.i.f. Liverpool	3	10	0	,,

OILS, etc.

		£	s.	d.	
Aniline Oil	...................................net	0	0	4⅝	per lb.
,, **Salt**	.... ,,	0	0	4½	,,
Castor Oil:	French, 1st pressure, f.o.b. Marseilles less 1½%.........	22	15	0	per ton.
	English, 1st pressure, f.o.r. Hull, less 2½%..............	23	5	0	,,
Cocoa Nut Oil:	Ceylon, ex store Manchester..............net	29	10	0	,,
	Cochin, ex store Manchester.. ....net	32	0	0	,,
Cotton Seed Oil:	Refined at Hull, less 2½% naked	14	2	6	,,
	Edible...at Hull, less 2½% naked	14	12	6	,,
Glycerine:	Crude, 80% .... net	31	0	0	,,
Linseed Oil:	Raw... ..at Hull, less 2½% naked	13	17	6	,,
	Boiled......at Hull less 2½% naked	14	17	6	,,
Starch:	American Pearl...at Manchester, net	8	15	0	,,
	Dextrine........... ,, ,,	18	0	0	,,
	Farina............... ,, ,,	15	15	0	,,
Shellac:	Standard TN orange spot	140/-			per cwt.
Turpentine:	American.........at Liverpool	38	0	0	per ton.
	Russian ....at Hull...net	19	0	0	,,

TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote:—

COLONIAL WOODS.

Timber.

		£	s.	d.		£	s.	d.
Quebec Square White Pine...	per cub. ft.	0	1	9	to	0	3	0
Quebec Waney Board Pine...	,,	0	2	8		0	3	9
St. John Pine, 18 in. average	,,	0	2	4		0	3	3
Lower Ports Pine...............	,,	0	1	3		0	1	8
Quebec Red Pine	,,	0	1	6		0	2	0
Quebec Oak, 1st quality	,,	0	2	9		0	3	4
Quebec Oak, 2nd quality ...	,,	0	1	6		0	2	6
Ash	,,	0	1	6		0	2	3
Elm	,,	0	3	3		0	3	10
Hickory	,,	0	2	0		0	2	6
Quebec Birch	,,	0	1	6		0	2	3
St. John Birch	,,	0	1	6		0	2	0
Birch Planks.....................	,,	0	0	9		0	0	11
Spruce Spars	,,	0	0	10		0	1	0

Deals.

		£	s.	d.		£	s.	d.
1st quality Quebec Pine	per std.	22	10	0	to	32	10	0
2nd do. do.	,,	17	0	0		22	0	0
3rd do. do	,,	11	10	0		13	0	0
St. John, N.B., etc., Spruce	,,	6	15	0		7	5	0
Lower Ports Spruce..	,,	6	10	0		6	15	0
Spruce Boards.................	,,	5	10	0		6	0	0

UNITED STATES, etc., WOODS.

Pitch Pine.

		£	s.	d.		£	s.	d.
Hewn	per cub. ft.	0	1	4	to	0	1	8
Sawn	,,	0	0	11		0	1	6
Planks, Stowage	,,	0	0	10		0	1	0
Boards, Prime	per std.	12	10	0		16	0	0
Oak Timber	per cub. ft.	0	1	6		0	2	6
Oak Planks	,,	0	1	6		0	2	1
East India Teak..............	per load	12	0	0		16	0	0
Greenheart.....	,,	6	15	0		7	10	0

EUROPEAN WOODS.

Timber.

		£	s.	d.		£	s.	d.
Riga Redwood	per cub. ft.	0	1	6	to	0	2	0
Dantzic and Memel Fir, Crown	,,	0	2	1		0	2	6
Dantzic and Memel Fir, Middling	,,	0	1	9		0	1	11
Stettin	,,	0	1	9		0	1	11
Swedish........................ ...	,,	0	1	0		0	1	3
Riga Whitewood	,,	0	1	0		0	1	3
Norway Mining Timber	,,	0	0	9		0	1	0
Dantzic and Stettin, etc., Oak..	,,	0	2	6		0	3	0
Norway Spars.................	,,	0	1	2		0	1	9

Deals.

		£	s.	d.	£	s.	d.
Red Archangel and Onega, 1st quality	per std.	19	0	0	20	0	0
Red Archangel and Onega, 2nd quality	,,	14	0	0	16	0	0
Red Archangel and Onega, 3rd quality	,,	10	10	0	12	10	
St. Petersburg, 1st quality...	,,	16	0	0	17	10	
Do. 2nd ,, ...	,,	14	0	0	15	0	0
Gefle	,,	11	10	0	16	0	0
Wyburg	,,	11	0	0	12	10	0
Uleaborg	,,	10	0	0	12	10	0
Gothenburg	,,	11	0	0	16	0	0

SELECTED PATENTS.

Compiled expressly for this journal by **Messrs. Page and Rowlingson, Engineering Patent Agents, 28, New Bridge Street, London, E.C.,** and at Manchester.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton Buildings, Chancery Lane, W.C., at the uniform price of 8d.

NEW PATENTS APPLIED FOR.

When Patents have been communicated the names of the communicators are printed in italics.

3466. F. T. Edgecombe, Glasgow. Feb. 20th.—An improved apparatus for steering and manœuvring ships.

3469. J. M. McClellon, U.S.A. Feb. 20th.—Improvements in and relating to water-tube boilers.

3472. E. C. Villiers and W. H. Smith, Windsor. Feb. 20th.—Improvements in steam generators or boilers.

3475. P. Decor, London. Feb. 20th.—Improvements in or relating to rotary engines and the like and means for regulating the same.

3484. R. Burow, London. Feb. 20th.—A grip wrench.

3487. H. H. Riggin, G. A. Patton, and J. T. Patton, Kingston-on-Thames. Feb. 20th.—An improved wrench.

3504. H. H. Lake, London. Feb. 20th.—Improvements relating to tube-plates for steam generators. (*J. J. Boyce, U.S.A.*)

3519. E. Beckert, London. Feb. 20th.—A new or improved method and apparatus for riveting small hinge pins, pivots, and the like.

3524. G. M. Harroway and W. Dixon, London. Feb. 20th.—Improvements in ships' construction.

3545, E. Mackay, Glasgow. Feb. 21st.—Improvements in and connected with indicators for steam, gas, petrol, and other engines.

3551. J. W. Glover, St. Helens. Feb. 21st.—An improved arrangement of machinery for driving, lifting, hauling, and loading (including lowering, winding, and unloading).

3557. G. Glossop, Sheffield. Feb. 21st.—Jam-thread lock-nut.

3581. W. H. Longsdorf and F. E. Jordan, London. Feb. 21st.—Improvements in and relating to steam generator and other furnaces.

3610. Siemens and Halske Akt.-Ges., London. Feb. 21st.—Manufacture of tools for working wood, metal, stone, or the like. (Date applied for Feb. 25th, 1904).

3621. H. F. Weinland, London. Feb. 21st.—Improvements in boiler-tube cleaners.

3626. H. C. Tryon, London. Feb. 21st.—Improvements in pipe couplings.

3627. H. Gilardoni and H. Leriche, London. Feb. 21st.—Improvements in speed gear. (Date applied for Feb. 22nd, 1904.)

3642. L. Baron, F. T. Bertwistle, and W. H. Spencer, Blackpool. Feb. 22nd.—A new or improved form of sand valve for tram and motor cars and other power-driven vehicles.

3657. S. B. Halcombe, P. MacGregor, J. Ainley, and W. O. Carrier, Sheffield. Feb. 22nd.—Improvements in the rolling of metals.

3659. H. Lister, Birmingham. Feb. 22nd.—Improved means for indicating and controlling the speed of steam turbines.

3668. G. A Nussbaum, London. Feb. 22nd.—Improvements in turbines actuated by elastic fluid.

3679. J. Holt, Birmingham, Feb. 22nd.—Improvements in screw propellers for ships, launches, and other like craft.

3680. A. H. Pehrson, London. Feb. 22nd.—Improvements in or relating to the production of bars, rods, tubes, blanks, and the like, direct from melted metal.

3682. S. Chandler, J. Chandler, and J. H. Solomons, London. Feb. 22nd.—An improved four-way safety and bye-pass valve for reversible condensers and other gas plant.

3684. E. Michael, London. Feb. 22nd.—Means for equalising the pressures in pumping and similar piston stroke engines.

3695. T. W. Hill, London. Feb. 22nd.—Improvements in burrs and rivets.

3701. D. Roberts and C. James, London. Feb. 22nd.—Improvements in chain-grate stokers.

3710. H. P. S. Wise and B. U. Boate, London. Feb. 22nd.—Improvements relating to variable speed gears.

3722. W. H. Porter, Manchester. Feb. 23rd.—Improvements in gas engines giving an impulse every stroke.

3723. J. P. Barker, Liverpool. Feb. 23rd.—Improvements in or connected with coaling ships at sea.

3732. W. Youdan and J. Tinsley, Sheffield. Feb. 23rd.—Improvements in devices for supporting colliery cages in case of accidents.

3739. J. Bedford, Sheffield. Feb. 23rd.—Improvements in the manufacture and treatment of compound armour plates.

3744. A. W. Knight, London. Feb. 23rd.—Improvements in rivets and washers.

3764. W. B. Thompson, Dundee. Feb. 23rd.—Improvements in or relating to governors.

3770. J. Craig, London. Feb. 23rd.—An improved method of obtaining motive power.

3776. F. W. Leevers, London. Feb. 23rd.—Improvements in stop and through-way valves.

3781. C. Goerg, Jun., and L. Christ, London, Feb. 23rd.—Improvements in and relating to rock drills.

3785. L. Silcott, London. Feb. 23rd.—Twyer-iron. (Date applied for March 7th, 1904.)

3790, L. Zamboni, R. H. Bowed, and the American Pulley Company, London. Feb. 23rd,—Improvements in or relating to pulley frames.

3800. A. V. Downton, Erith. Feb. 23rd.—A new type of stranding machine or machines for stranding up of copper, iron, steel wires, and its like.

3807. W. G. A. Bijl, London. Feb. 23rd.—Improvements in or relating to riveting machines.

3811. C. Brvant, London. Feb. 23rd.—An improved form of link, hook, coupling, or connector.

3821. A. C. E. Rateau, London, Feb. 23rd.—Improvements in means for the propulsion of screw steamers. (Date applied for March 1st, 1904.)

3822. A. C. E, Rateau, London. Feb. 23rd.—Improvements in apparatus for governing engines driven by steam from different sources at different pressures. (Date applied for March 2nd, 1904.)

3823. G. B. Hunter and W. M. Webster, London. Feb. 23rd.—Improvements in and relating to movable stages for building purposes.

3833. J. Wood, Liverpool. Feb. 23rd.—Improvements in apparatus for preventing overwinding at collieries, mines, or other places.

3840. C. Davies, Blaenavon. Feb. 24th.—Haulage clip.

3866. W. M. Bocquet, Bedford, Feb, 24th.—Improvements in blast pipes for steam locomotive engines.

3867. R. Lomax and J. Tomlinson, Manchester. Feb. 24th.—Electrical apparatus for automatically controlling the pressure of steam in boilers.

3872. H. Green, Tondu, Glam. Feb. 24th.—Improvements in the axle boxes of railway and tramway rolling stock and other vehicles.

3883. J. Corbett and F. B. Kilpatrick, Glasgow. Feb. 24th.—Improvements in pumps.

3886. J. H. Wynn, London. Feb. 24th.—Improvements relating to adjustable spanners.

3892. W. R. Smith, London. Feb. 24th.—Improvements in elastic fluid turbines.

3916. W. P. Thompson, Liverpool. Feb. 24th.—Improvements in check valves. (*C. L. Schoville, U.S.A.*).

3926. E. Eberhardt, London. Feb. 24th.—Improvements in or connected with fire-tube boilers. (Date applied for May 6th, 1904.)

3937. C. Greenhalgh, Bolton. Feb. 25th.—Screw propeller for turning ships.

3944. R. Kennedy, Glasgow. Feb. 25th.—Improvements in utilising exhaust gases from internal combustion engines and in apparatus therefor.

3953. C. W. Siddle and L. Cousen, Huddersfield. Feb. 25th.—Improvements in or appertaining to differential or variable speed gears or motions.

3959. J. Parker, Huntington. Feb. 25th.—Steam scurfing bar.

3961 A. H. Moorhouse, Manchester. Feb. 25th.—Improvements in screw-down valves.

RECENT SPECIFICATIONS.

SUPERHEATERS.

Willans and Robinson, Ltd., and A. T. Bennett, of Rugby. March 19th, 1904.—This invention is especially applicable to water-tube boilers in which the tops of the tubes are not rendered inaccessible by being covered over by the steam-and-water drum. The superheater consists of two small drums, conveniently consisting of solid-drawn tubes a few inches in diameter, with end covers bolted on to flanges. The two drums lie side by side upon the top of the boiler, and are connected by U-shaped tubes, one end of each tube being expanded into each drum. The two drums may be for convenience fixed or tied together by straps or frames. The U tubes hang down amidst the water-tubes, but do not extend down to the fire or into any part of the combustion space where the temperature greatly exceeds 1,000 deg. F. In order that the main portion of the heating surface may be in that region of the furnace where the temperature is most suitable for superheating purposes, each U tube is formed with a coil or convolutions at its lower end. There will then be no portion of the U tube in such a position as to be exposed to heat undesirably great, and the only portions of the U tube which pass through that part of the furnace in which the temperature is lower than is desirable for superheating purposes, are the two legs of the U.

Fig 1

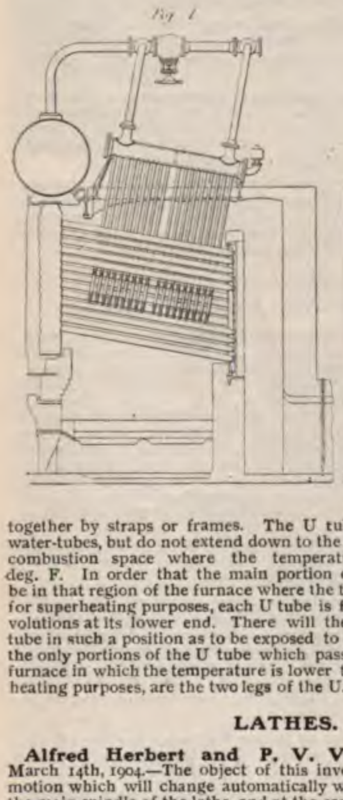
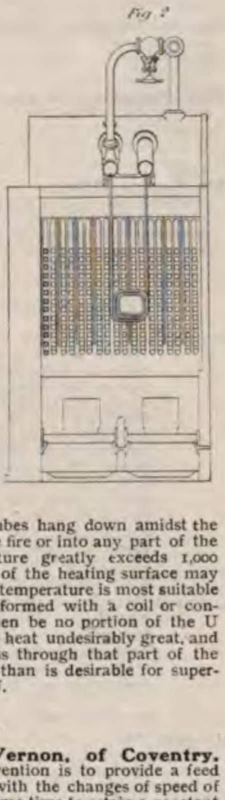


Fig 2



LATHES.

Alfred Herbert and P. V. Vernon, of Coventry. March 14th, 1904.—The object of this invention is to provide a feed motion which will change automatically with the changes of speed of the main spindle of the lathe, and at the same time to retain a constant rate for the high speed of the cam shaft independent of variations in the slow or feeding speed, and the improvements also embody a device for enabling the feed to continue to run in the same direction even when the spindle of the lathe is reversed. The mechanism and gearing of the invention is as follows: the cam shaft is provided with a worm wheel which is driven by a worm from the main worm shaft, a safety friction clutch is provided on the main worm shaft, and means for engaging or disengaging by hand the parts of the safety friction clutch. A handwheel and clutch are provided by which the main worm shaft can be rotated, and a sliding secondary worm shaft driving by worm gear the main worm shaft. A quick-speed driving pulley and a sliding clutch revolving therewith are loosely connected on the main worm shaft; means for connecting and disconnecting the sliding clutch with a clutch on the main worm shaft are described. A nest of toothed gears are loosely mounted on the sliding secondary worm shaft, and a nest of toothed gears keyed on an auxiliary shaft and always gearing with the aforesaid nest of toothed gears on the secondary worm shaft. A spring key is provided in a slot in the sliding secondary worm shaft, and means for giving a sliding motion to the said secondary worm shaft in order to enable the spring key to key any one of the first-named set of tooth gears to the secondary worm shaft, and also means for communicating motion from the main driving spindle to the lathe of the variable feed gear.

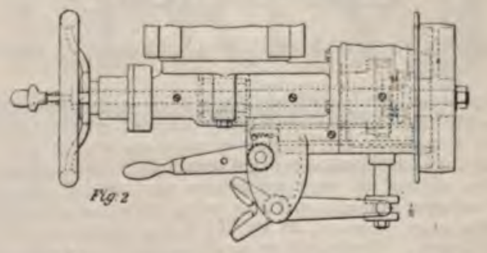


Fig 2

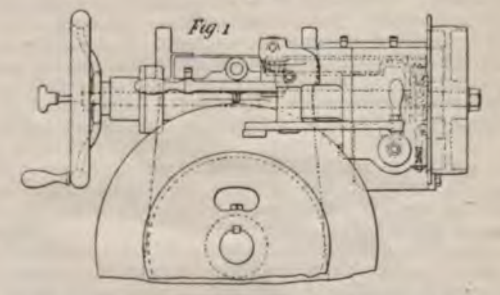
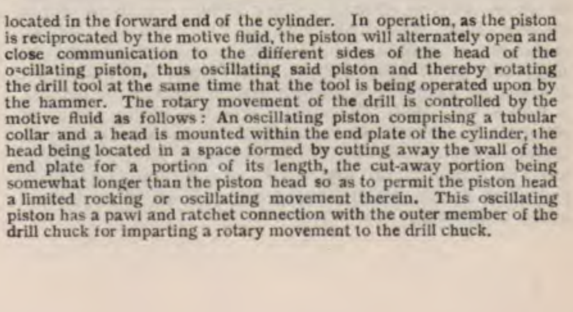


Fig 1

DRILLS.

Lake (communication from Ingersoll-Sergeant Drill Company, of New York). Dec. 13th 1904.—This invention relates to an improvement in drills and has for its object to provide certain improvements in that class of drills known as hammer drills. The drill is of the portable type in which the cylinder is provided with a handle, which handle is provided with the usual inlet valve for the motive fluid and controlling device therefor. A duct leads from the handle to an inlet port opening into the interior of the cylinder, intermediate the ends of the piston chamber in position to be brought into open communication with the one or the other of two ports through an annular circumferential groove in the piston. The piston is provided with a forwardly projected hammer fitted to strike the rear end of the shank of the drill. This hammer is fitted to slide in a tube, located in the forward end of the cylinder. In operation, as the piston is reciprocated by the motive fluid, the piston will alternately open and close communication to the different sides of the head of the oscillating piston, thus oscillating said piston and thereby rotating the drill tool at the same time that the tool is being operated upon by the hammer. The rotary movement of the drill is controlled by the motive fluid as follows: An oscillating piston comprising a tubular collar and a head is mounted within the end plate of the cylinder, the head being located in a space formed by cutting away the wall of the end plate for a portion of its length, the cut-away portion being somewhat longer than the piston head so as to permit the piston head a limited rocking or oscillating movement therein. This oscillating piston has a pawl and ratchet connection with the outer member of the drill chuck for imparting a rotary movement to the drill chuck.

Fig 1



NEW PUBLICATIONS.

"THE PROCESS YEAR-BOOK."

Penrose's Pictorial Annual, 1904-5. Edited by William Gamble. Penrose and Co. 4s.

The relationship between this "illustrated review of the graphic arts" and engineering may not at first sight be very apparent; but engineers who are called upon to undertake the production of catalogues will find the above annual at once suggestive and useful. In fact the volume actually includes some very fine specimens of the engravers' art, as applied to the representation of machinery. Three-colour work as usual provides the dominant interest, the present volume reaching a high level considered as an art production. Incidentally we are reminded once more how much the printer and illustrator owe to the engineer. The volume itself is a remarkable specimen of typography, in view of the fact that every line of it has been turned out by the Lanston Monotype Machine. Among the articles is a retrospective account of the routing machine, which, to quote the author, has "been transferred from an awkward machine, that roughly hewed out the wood with no pretence of efficiency, into a wonderful piece of mechanism gliding into a plate with a cutter revolving at the rate of fourteen or fifteen thousand revolutions per minute, capable of piercing the most acute angles, and of executing the minutest work with the highest degree of efficiency."

"POCKET BOOK OF MARINE ENGINEERING RULES AND TABLES."

For the use of Marine Engineers, Naval Architects, Designers, Draughtsmen, Superintendents, and all engaged in the design and construction of marine machinery, naval and mercantile. By A. E. Seaton and H. M. Rounthwaite. Eighth edition. Charles Griffin and Co., Ltd. 7s. 6d.

In this new edition the editors have exercised due discretion in the task of revision, the result being that the value of this pocket book is still further enhanced. All the recent alterations and additions to the rules of the Board of Trade, Lloyd's Registry, the Bureau Veritas and the British Corporation have been included. Marine engineers will find the new formulæ and tables relating to the speed of ships of practical utility in determining more accurately the horse-power necessary for the speed of all kinds of steam vessels. The book which is illustrated, is suitably bound in limp leather.

We have also received "The Bi-Monthly Bulletin of the American Institute of Mining Engineers" (Philadelphia).—"Arc Lamps and How to Maintain Them," by H. Smithson and E. R. Sharpe (S. Rentell and Co., Ltd. 1s.) An elementary booklet compiled by two experienced electricians for the use of those having charge of arc lamps; without going deeply into electrical matters, the writers impart sufficient information to enable a "handy man" to negotiate small breakdowns, and secure the maximum amount of light for a minimum expenditure of capital. —"The Oil Mills Directory, 1905-6," being a list of oil manufactures in Great Britain, including extractors, boilers, distillers, etc. (Simpkin, Marshall, Hamilton, Kent and Co., Ltd. 2s. 6d. net.) A handy volume, containing technical details of the firms engaged in the oil and allied industries.

BOOKS RECEIVED.

Gas and Petroleum Engines. Translated and adapted from the French of Henry de Graffigny. Edited by A. G. Elliott, B.Sc. With fifty-three illustrations. Whittaker and Co. 2s. 6d.

The Engineering Diary and Pocket Magazine, February 1905. (17, Bouverie Street, E.C.) 6d.

The Imperial Directory and Statistics of Electric Lighting, Power and Traction Works in operation or projected in Great Britain and Ireland, India, and all the British Colonies. By C. S. Vesey Brown. Hazell, Watson and Viney, Ltd. 12s. 6d. net.

The Mining Year-Book, 1905. Edited by A. N. Jackman. Published by "The Financial Times," Ltd. 15s. net.

The Inventors' Guide to Patent Law and the New Practice. By James Roberts, M.A. LL.B. John Murray. 2s. 6d.

CATALOGUES.

Mr. Fred J. Down, M.I.E.E., F.C.S., A.M.I.C.E., of 6, 7. and 8, Crutched Friars, E.C., draws attention in a circular to his gear shield, a method for retarding wear on new gears and arresting excessive wear on gearing.

Messrs. David Bridge and Co., of Castleton, Manchester, forward a booklet containing over seventy illustrations of india-rubber and gutta percha machinery. The firm give particular attention to the designing of special machinery for carrying out manufacturers' own private processes or methods.

Special Circular No. 9 of the Consolidated Pneumatic Tool Company, Ltd., illustrates and describes the firm's "Little Giant" and "Whitelaw" Pneumatic Drills, the Boyer Hammer, Improved Rock Drills, Stone Hammers, etc.

The Kennicott Water Softener Company, 29, Great St. Helen's, E.C. We have received from this firm an attractive little booklet describing their "Tipping Box Type" of Water Softener. It is claimed that the entire cost for softening water by the Kennicott system averages from ½d. to 2d. per thousand gallons.

Mr. Henry Milnes of Ingleby Works, Bradford, illustrates and describes his various lathes, accessories, and machine tools in a handy booklet. This is well arranged and the compilers have also given it the benefit of an index. The printers are Messrs. Arthur Stafford and Co., of Central Works, Denton, Manchester.

MEETINGS FOR THE ENSUING WEEK.

FRIDAY, MAR. 10.—Rugby Engineering Society, 8 p.m.: Paper, "The Minute Structure of Metals," Mr. J. T. Milton.—Physical Society.—Royal Society.—Royal Institution: Paper, "Structure of the Atom," Professor J. J. Thompson, F.R.S.—Civil Engineers, Great George Street, S.W., 8 p.m. (Students' Meeting.) 1. Mr. F. G. Helsby, "The Purification of Sewage." 2. Mr. F. O. Kirby, "The Purification of Sewage by Hydrolysis and Oxidation."—Astronomical, Burlington House, W., 8 p.m.—Physical Society, South Kensington, S.W., 8 p.m.; Paper, Dr. C. Chree, "The Stresses in the Earth's Crust before and after the Sinking of a Bore-Hole."; Mr. J. Morrow. "The Lateral Vibration of Bars of Uniform and Varying Sectional Area"; Mr. A. Campbell, "Direct Reading Resistance-Thermometers, with an Appendix on Composite Thermocouples."—Manchester Local Section Electrical Engineer's: Annual Dinner.

SATURDAY, MAR. 11.—Royal Institution, Albemarle Street, W., 3 p.m.; "Electrical Properties of Radio Active Substance," Professor J. J. Thompson.—Manchester Association of Engineers, Grand Hotel, 8 p.m.: Paper, "Recent Developments in Locomotives," Mr. Samuel Rendell.—Junior Institution of Engineers, 3 p.m.: Visit to New Ritz Hotel, Piccadilly. to inspect the "cage skeleton" system of constructional engineering.

MONDAY, MAR. 13—Institution of Marine Engineers, Romford Road, Stratford. 8 p.m.: Paper, "The Development of the Torpedo-Boat Destroyer," Mr. J. W. Harding.

TUESDAY, MAR. 14.—University of Liverpool Engineering Society; Paper, "The Theory of the Internal Combustion Engine," Professor Burstall.—Institution of Electrical Engineers, Glasgow Local Section; Manchester Local Section.

WEDNESDAY, MAR. 15.—Dundee Institute of Engineers, Paper "Dynamos and Motors from the Users Point of View, Mr. David Scott.

THURSDAY, MAR. 16.—Institution of Electrical Engineers (Leeds Local Section): Paper, "Power-Gas," Dr. F. H. Bowman.—Institution of Mining and Metallurgy.

FRIDAY, MAR. 17.—Institution of Mechanical Engineers, Storey's Gate, 8 p.m.: Presentation of Report of Steam Engine Research Committee.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

VOL. VI. LONDON, FRIDAY, MARCH 17, 1905. No. 27.

The Offices of "Page's Weekly," Wednesday Evening.

WE are glad to see that the Times is calling attention to the form of protest which has been drawn up in opposition to the new Board of Trade Patent Rules. This list is now of a very influential and representative character. The point at issue concerns the market value of Letters Patent as it may be affected by an official endorsement recording the numbers of previous patents that may or may not anticipate the invention. The alternative suggested is that the patentee himself should be allowed to state in his specification that he is aware of previous applications, setting them forth in a concise form, the effect of which would be to show that he had patented the article with his eyes open to the state of the art, and that he believed himself to have accomplished something novel and useful. Those who are anxious to consider for themselves the pros and cons of this question cannot do better than read the interesting discussion initiated a few weeks ago in these columns by Mr. B. H. Thwaite.

———.

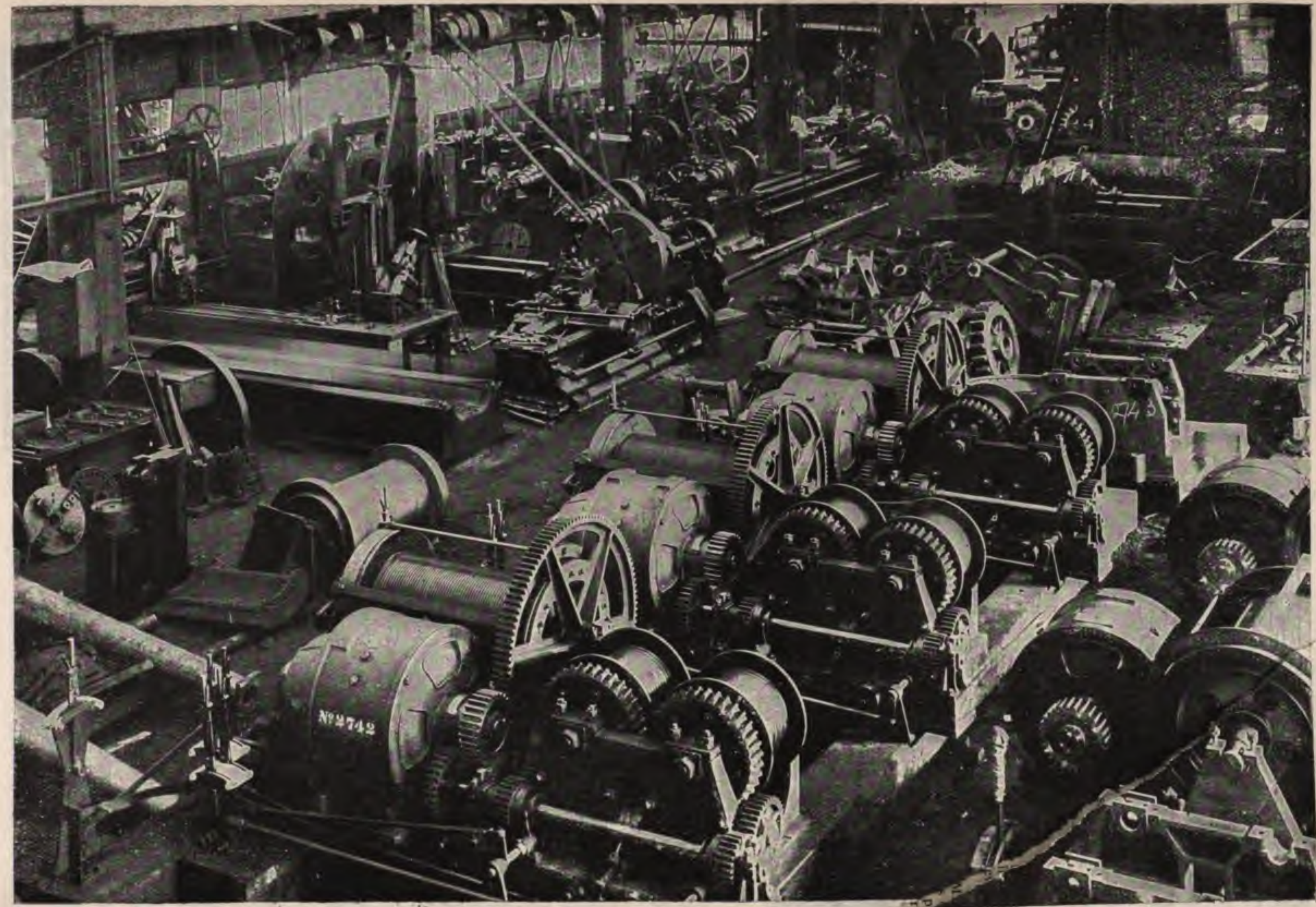
At the recent meeting of the South Staffordshire Mond Gas Company, Mr. Alfred Mond, presiding, said they hoped to begin very shortly making and distributing Mond gas. They had already a good many customers to take the gas, and were now in negotiation with one of the largest firms in the district for a large supply. Others were waiting to see the result, and as soon as they were satisfied that it would be an economy to use it—he did not anticipate this would take long, judging from the satisfactory report they had from the North—they felt sure there would be plenty of customers

Photo by Elliott and Fry.]

MR. WILLIAM FRECHEVILLE, A.R.S.M., F.G.S.

Who has just been elected President of the Institution of Mining and Metallurgy.

Mr. Frecheville was born in Canada in 1854, received his primary education at Berlin, and subsequently became a student at the Royal School of Mines, London. He has travelled very extensively, and gained mining experience in South Africa, Mexico, the United States, and India. During recent years he has had offices in London. He is a Member of the American Institution of Mining Engineers.



ELECTRICALLY EQUIPPED WINCHES FOR THE ADMIRALTY FLOATING COAL DEPOT, PORTSMOUTH.

The above view is from the Witton Works of the General Electric Company, Ltd., and shows the appl cation of sixteen Witton Continuous Current Motors, each of 35 to 40 h.p. to winches for use in connection with the Temperley Transporters installed on the Admiralty Floating C al Depot (12,000 tons capacity) stationed at Portsmouth Dockyard.

The Company have also supplied four Witton Motors, each of 12 h.p., which are used fo travelling the towers along the deck. It is interesting to note that the transporters in question can coal two battleships of the *Majestic* class at the same time, placing from 500 to oo tons of coal per hour on board.

to take all the present make. Then would be the time to consider the enlargement of the works. They hoped in a few months to be able to distribute gas. They had made a contract with a large consumer which would enable them to dispose of a large quantity of gas on terms favourable to the company. The development of the scheme would take time, and that time would depend on the consumers and shareholders. They were anxious to do all they could to help the manufacturers to use the gas. He was glad to see there were many consumers beginning to take a more active part in the matter. Some people exaggerated the little difficulties that were met with. That the company would some day be one of the soundest companies in the country he had no reason to doubt, but neither he nor anyone else could say how long this would take.

The revenue accounts and analysis of working which are published as annexes to the most recent report on the Uganda Railway show that steady progress is being made in public traffic, excluding railway material. At the beginning of the year under review, the traffic working was carried on at considerable disadvantage owing to the line being still incomplete in many respects, while from April to September, 1903, heavy rains between the Mau Summit and the Lake terminus caused much delay, and undoubtedly interfered with the development of public business. The mean mileage worked during the year was 584 miles, the full extent of the railway. The point most noticeable in the year's working is the increase in the downward traffic from the Lake to the coast, as compared with the upward or import traffic, which remains, so far, almost stationary. This increase brings the downward traffic to 35 per cent. of the whole tonnage carried, as against 21¾ per cent. for 1902, and 11⅛ per cent. for 1901. Much of this increase is due to the traffic brought in by the Lake steamers—traffic which has the great advantage, so far as the railway is concerned, of passing over its whole length.

In preparing the forecast of expenditure for working and maintaining the railway for the year under review it was estimated that the expenditure would exceed the receipts by £65,000. The actual deficit was, however, somewhat less, viz., £60,100. During the second half of the year the traffic was well maintained. The original estimates for the current year's (1904–1905) working showed a loss of £45,000, but the manager's revised estimates, prepared in November, 1904, show a deficit of £10,000 only, while it is expected that a further reduction will take place in 1905–1906. It should be remembered, in reference to this loss on working, that all Protectorate stores are carried at actual cost price—no profit being earned—and that, without the facilities afforded by the railway the cost to the State of holding Uganda and the head waters of the Nile would have reached a sum many times greater than this apparent deficit. The cost of carriage of the amount of Government stores now used in the Uganda Protectorate, by the old method of porters, would not only be sufficient to obliterate the deficit, but to pay a small percentage on the capital cost of the railway as well.

The results of the working of the Lake steamers are encouraging. For the first ten months, only one steamer was in service, the second having been launched and completed just in time to commence work in February, 1904. Arrangements have now been made for the provision of a third steamer. The traffic in the products of the country more than doubled during the year, and with the present large influx of whites who are desirous of settling in Uganda there is little doubt that, should these settlers find the country answers to their expectations, the imports will again increase. A further instalment of Mr. Leyland's article on the railway commences on page 577.

At the annual meeting of the Association of Mine Managers of the Transvaal, Mr. H. Ross Skinner, the retiring president, reviewed the work of the year in the mining industry from the practical point of view of the mine manager. He remarked that during 1904 the mining industry of the Transvaal had made greater progress than it had ever done in any individual year. This progress had been brought about by the great increase in the unskilled labour forces of the mines, mainly due to the successful introduction of the now proved Chinese. They started the year 1904 with about 75,500 natives in the coal and gold mines, and now the return was about 88,000 as the number of natives working on the fields on January 31st, an increase of about, say, 12,500. This total, added to the total Chinese at work and on the water, brought the unskilled labour army of the mines far ahead of what it had ever been. As regards Chinese, the first shipment arrived in the month of June, 1904, and on January 31st, 1905, there were 27,197 in full work along the reef and 7,514 on the water due to arrive on the mines at a very early date.

The full force of this great army of unskilled labour had not yet had time to make itself felt, but it needs no astute prophet to prophesy that in a few months' time the output of gold and profits to be derived from the Transvaal mines would exceed those of any pre-war days. Many causes would tend to this desirable state of things, the two main causes being increase of tonnage mined and treated, and decrease in working costs. Increase in tonnage would be brought about mainly by the augmentation of labour force, both skilled and unskilled; the decrease in costs by the greater efficiency of labour, reduced cost of stores, and last but not least the general tendency to a gradual improvement in the handling and management of the mines. In the pre-war days a mine considered itself lucky and its compound well managed if it could get an average of 80 per cent., or a little over. of its labourers daily at work; to-day the average percentage was 92, and some mines had reached 95 per cent. or over. This change was due to the strict suppression of the liquor traffic amongst natives, and to this trampling underfoot of the illicit liquor dealing they had to ascribe the quiet and peaceful week-ends on their mining properties instead of the drunken orgies which formerly took place every Sunday, lasting sometimes well into the week. Another great drawback, the old Pass Law, as it was administered, was now a thing of the past and almost forgotten. In its place they had a very much improved system, which was being most efficiently carried out. The native of to-day was better fed, better housed, and, when sick, better attended to than of old, and looking at the matter from a purely financial point of view, he was sure that the companies benefited by the change, and would do so, so long as the treatment of natives was carried out on the present common-sense lines, and provided that they did not run into extremes.

With reference to the health of underground workers, the condition of rock drill miners appeared to be much better. But those of them who came into contact with and had personal experience of these men realised how difficult it was to induce them to make use of the simplest precautions. Mine captains, shift bosses, and all complained of the difficulty experienced in inducing them to employ the proper and necessary preventatives. In his opinion, men working in ends and raises should be compelled by law to spray the faces of same at stated frequent intervals, and when boring up-holes, even with a water jet, to wear respirators. Mr. Skinner, it will be remembered, was the author of the now famous report on Chinese labour. The new president elected at this meeting was Mr. H. Spencer.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

DAVIDGE PAGE, Editor.

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Editorial.—*All communications intended for publication should be written on one side of the paper only, and addressed to "The Editor."*

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New Copy for Advertisements,

Alterations, &c., intended for insertion in the current week's issue must be delivered **not later than 4 p.m. on Monday.** If proofs are required the copy and blocks should reach us several days earlier.

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NEWS ITEMS.

Mr. W. B. Worthington, engineer of the Lancashire and Yorkshire Railway, has accepted the post of engineer-in-chief to the Midland Railway.

The late Mr. James Edward Ransome, chairman and managing director of the engineering firm of Ransomes, Sims, and Jefferies, Ltd., Ipswich, left property valued at £163,349 gross.

The title of the Mechanical Engineers' Association of the Witwatersrand is likely to be altered. It is certainly somewhat cumbersome. The new title proposed for the association is "The Transvaal Institute of Mechanical Engineers."

The Commission appointed by the Treasurer of Cape Colony to inquire into the financial position and general working of the Table Bay Harbour Board, urges that the authorised works, which will absorb £126,735, be proceeded with immediately.

Lord Kelvin will be the recipient of the first John Fritz gold medal awarded by the joint committee of the four national American engineering societies, under the deed of gift, to the man most representative of, and eminent in, scientific advance in the engineering field.

The transference of the locomotive works of the London and South-Western Railway Company from Nine Elms, London, S.W., to Eastleigh, Hampshire, will mean the removal of 3,000 employees with their families—about 12,000 persons in all. Most of these reside at Battersea.

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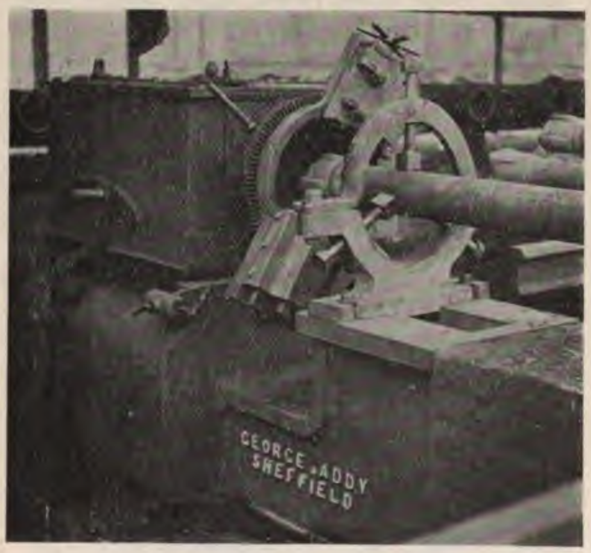
Bromley Destructor.

Bromley destructor, in which the fires were lighted last October, presents many points of special interest, and is one of the three destructors in which the refuse is tipped directly from the carts into the destructor cell without any intermediate handling or expenditure of labour whatever. The three destructors in question are situated at Westminster, Blackpool, and Bromley, and are all of the Horsfall type.

The tipping floor at Bromley is approached either by an inclined road or by a steam-driven hoist, which raises the horse and cart to the upper level. Having arrived on the tipping platform the cart is backed up to the feed hole of one of the three furnaces, the charging door is opened and the hopper lowered into its place. The cart tips its load bodily into the furnace, and the charging door is then immediately closed. The whole operation of opening the door, adjusting the hopper, tipping the cartload into the cell, raising the hopper, and closing the door, occupies less than half a minute. The door when closed dips all round into a water seal, which prevents the escape of smoke and dust, and also prevents the door from being burnt out.

Each cell is capable of burning from 10 to 15 tons of refuse per 24 hours. The hot gases pass out from the destructor by patent front exhaust flues, and are thoroughly mixed in a large combustion chamber contained within the furnace block before passing to the boiler. This is of the Babcock and Wilcox make of the improved marine type. It has 1,700 square feet heating surface, and a working pressure of 120 lb. per square inch. The boiler is capable of developing 250 h.p. It is provided with a direct-acting flywheel feed pump and an injector as a standby.



NEW ELECTRICALLY DRIVEN CUTTING-OFF LATHE.

The flues are carefully designed and built, and between the boiler and the chimney is fitted a centrifugal dustcatcher—the joint patent of Mr. Newton (borough engineer of Accrington), Mr. Diggle (the cleansing superintendent), and Mr. G. Watson (of the Horsfall Destructor Company). It consists of a circular chamber in which the gases are given a swirling motion causing the dust to be driven by centrifugal force through a narrow opening into the cleaning pit constructed on the outside of the dustcatcher. This arrangement has been proved capable of catching over 98 per cent. of the dust contained in flue gases, and it can be cleaned out at any time without interfering with the working of the plant.

An Advance in Cast Iron Pipe Foundry Practice.

Electrically driven machines of all kinds are coming increasingly into general use owing to the fact that line shafting can be entirely dispensed with and the electrically driven tool can be dropped down, as it were, in any part of the works without a thought having to be given to the presence in the immediate neighbourhood of shafting and pulleys. The accompanying illustration of an electrically driven cutting-off lathe gives an admirable example of the convenient manner by which work in cast-iron pipe foundries can be arranged.

The pipes, having left the foundry, are passed on to the fettlers, who, having completed their portion of work, roll the pipes down an inclined gangway to the electrically driven cutting-off lathe, which intercepts each pipe on its downward path, cuts off the rough end, and then allows the finished pipe to pass on to the dipping tank and the railway wagon. The cost of handling is thus enormously reduced.

The lathe has six changes of spindle speed without altering the speed of motor, and is fitted with an ingenious cutting-off head (Addy's Patent, No. 20,466), which is a great "time-saver," as the tools can be instantly brought up to the cut or instantly released by means of the projecting handles shown in photo.

The patent cutting-off head is equally suitable for cutting off large forged steel shafts, etc. The accompanying illustration is reproduced by the courtesy of Mr. George Addy, of Sheffield, who has devoted particular attention to the machines required by pipe founders, and we are informed that, in several cases, the cost of machining the pipes has been reduced by 50 per cent.

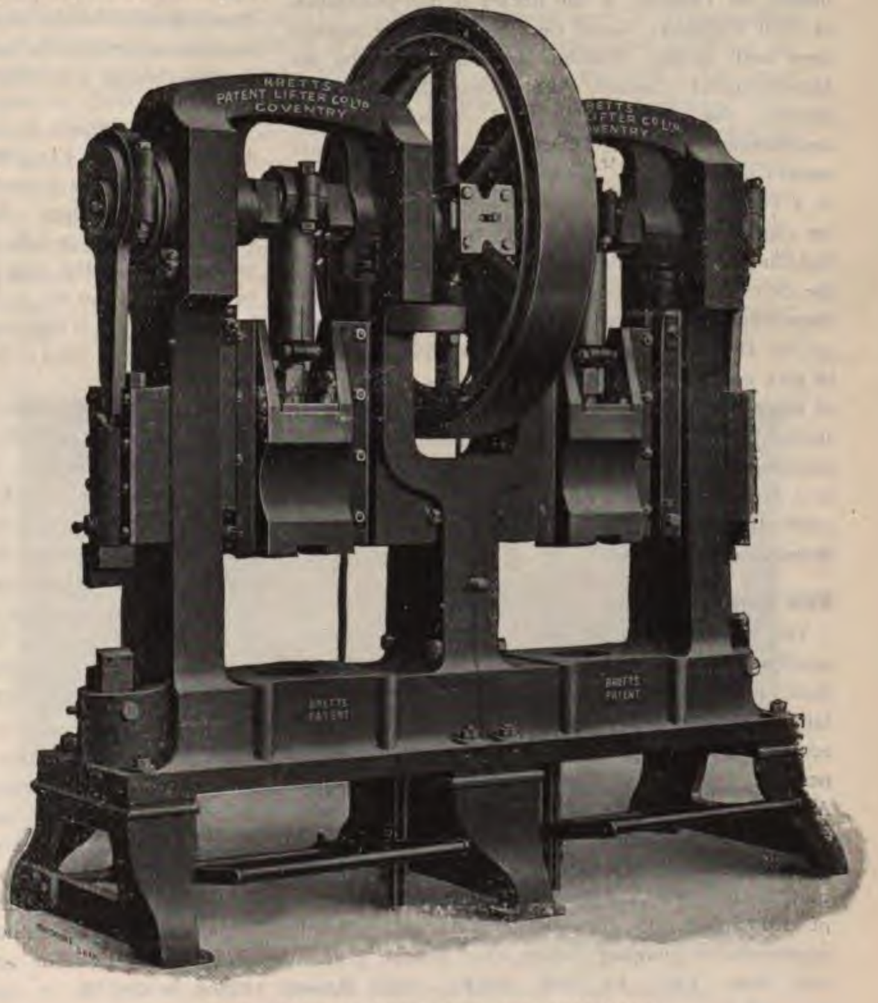
Clipping Press by Brett's Patent Lifter Co., Ltd.

The rapidly increasing use of accurately finished die stampings has led the Brett's Patent Lifter Company, Ltd., of Coventry, to design several forms of clipping presses specially adopted for this particular work, and the machine illustrated is one of their latest productions. In all forms of hot stamping with dies a certain amount of fin or flash is left at the joint where the faces of the top and bottom dies come together, and, although with accurately made and carefully set tools this is reduced to a minimum, it cannot be entirely avoided, and some system is necessary for its removal. In most modern works, where this method of die forging is adopted, it is now customary to provide for the purpose some form of press which is fixed side by side with, or in close proximity to, a furnace and stamp, so that each workman has a complete plantfor turning out a finished stamping.

The machine illustrated is in reality two complete presses but arranged for economy of space and convenience of working as a single machine, each part of which is operated quite independently of the other, and has in addition to the table for reception of the clipping or trimming dies, a separate pair of shears for cutting off the scrap ends from the bar on which the forging is made.

In every form of press for this purpose (or indeed for any other purpose where continual running is unsuitable) some ready and reliable form of starting motion by which a single stroke of the machine can be obtained is necessary, and by a very ingenious patented arrangement the machine not only contains this, but also ensures that the slide of the machine shall come to rest at the top of the stroke ready for the next operation, or that, if required, a continuity of strokes can be had. This has to be controlled by the foot.

The flywheel is fitted with a hardened steel square driving bolt, fixed either in the boss of the wheel as illustrated, or sometimes in the rim, but in either case free to slide sideways and having attached to it a finger piece passing at each revolution through a taper guide quadrant, so arranged that by depressing the foot lever it will be moved sideways, and draw the bolt in the wheel far enough to come in contact with the hardened face of a steel driving arm which is securely keyed on to the crank shaft and so made to revolve. On releasing the treadle the quadrant returns to its normal position and pushes back the driving bolt so that at the moment of passing the quadrant (or at top stroke), the arm on the shaft will be released and the machine stopped.



NEW CLIPPING PRESS FOR DIE STAMPINGS.

Forthcoming International Congress at Liege.

In connection with the Liége Universal Exhibition, an International Congress of Mining, Metallurgy, Mechanics and Applied Geology will be held at Liége from June 26th to July 1st. As already announced, the Mechanical Engineers' meeting in Belgium closes on June 24th, so that members attending the meeting will have an excellent opportunity of attending the congress. The Congress is convened under the patronage of the Government, and is organised by the Union of Collieries, Mines and Ironworks in the Province of Liége and by the Liége Engineers' Association (Association des Ingénieurs sortis de l'Ecole de Liége). Further details will be given next week.

Meteorological Exhibition.

An exhibition of meteorological instruments, organised by the Royal Meteorological Society, was opened on Tuesday, in the library of the Institution of Civil Engineers, Great George-street, and remains open until to-day. Exhibits are contributed by the Meteorological Council, the Royal Meteorological Society, the National Physical Laboratory, the Astronomer Royal, Dr. H. R. Mill, and many private owners and makers. At one end of the room there is a collection of instruments, many self-recording, for registering the direction and force of the wind, including a couple that went to the Antarctic with the *Discovery;* and close by there is a series of sunshine-recorders of various types, some of which, used by the *Discovery*, had to be specially designed so as to give continuous records for 24 hours. The centre of the room is occupied by a typical "climatological station," fully equipped with dry bulb, wet bulb, maximum and minimum thermometers, all mounted in a Stevenson screen, rain gauge, sunshine recorder, earth thermometer, etc., as recommended by the Meteorological Society.

New Graving Dock.

The annual report of the Belfast Harbour Commissioners shows that the contractors, Messrs. Walter Scott and Middleton, Ltd., of London, have made fair progress with the new graving dock, and in connection with this work additional contracts have also been entered into with the following firms: Messrs. Andrew Barclay, Sons and Co., Ltd., of Kilmarnock, for engines and pumping machinery; Messrs. Hanna, Donald and Wilson, of Paisley, for travelling caisson and folding bridge; Messrs. Glenfield and Kennedy, of Kilmarnock, for penstock sluices and hydraulic appliances for pumping station, etc.; Messrs. J. Moore and Sons, Ltd., for keel blocks, and Messrs. H. and J. Martin, for the construction of a timber wharf.

It is stated that some of the Scotch shipbuilding firms have now enough work on hand to keep them busily employed for the next two years.

At the spring general meeting of the Marine Motor Association on the 30th inst. among the items for discussion will be Mr. William Cross's proposed new rule for ascertaining the power of steam motors, and a proposal that the Association should undertake the carrying out of official speed trials of motor boats and the issuing of certificates of speed performances.

At the annual meeting of the Leeds Forge Company, Ltd., last week, the chairman, Mr. Bernal Bagshawe, the new chairman of the Leeds Forge Company, Ltd., referred to the complete reorganisation of the steel-plate rolling plant. The most modern corrugating mil had been established, and the hammering of stee ingots had been abandoned. When in the United States recently he had seen nothing to surpass the new methods adopted at the Leeds Forge, but improvements at these works were still in progress.

Without reference to repatriation, compound and dietary features, it has cost about £400,000 to "successfully introduce" the 27,200 Chinese employed on the Rand at the end of January. Some remarks by Mr. Skinner on Chinese labour and the general outlook will be found on page 560. If the 1904 basis of production elsewhere be maintained and not increased proportionately to that of these fields, it is calculated that the Transvaal in 1905 will contribute a third of the world's gold.

Cordingley's Motor-car Exhibition opens to-morrow at the Agricultural Hall, and will be continued until the following Saturday. This will be the tenth annual event of the kind which Mr. Charles Cordingley has organised at this hall, and we are informed that the latest types of touring and light vehicles will be on view, while the display of light delivery vans will give the event an interest for all who look to the motor-car to help in the solution of the difficulties of delivery experienced by commercial houses. In the heavy vehicle section there will be a large display of motor-'buses, municipal vans for street watering and the collection of dust lorries, etc. The Aero Club is organising a special display of balloons, airships, etc. During the week the annual meeting of the Motor Van and Wagon Users' Association will be held, and a reception will also be accorded to the borough and district engineers and surveyors who have been deputed by their authorities to make an inspection of the exhibits. The annual meeting of the Motor Union is also to be held during the week at the Agricultural Hall.

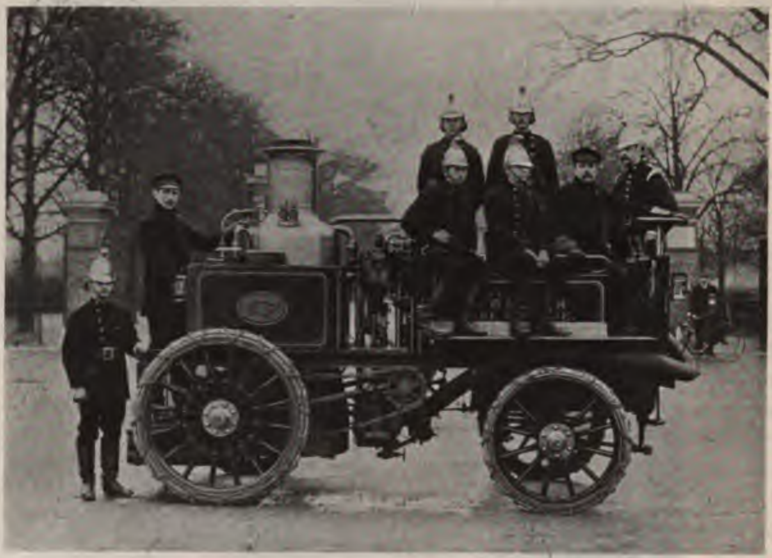
New Motor Steam Fire-Engine for the L.C.C.

THE new steam motor fire-engine supplied to the order of the London County Council for the London Fire Brigade, appears to have been rather unfortunate on its trial run to Sevenoaks. Several inaccurate versions of the incident having been given in the press, it may be well to briefly state the facts. It seems that the new engine got into some soft stuff on a by-road. In the efforts to get out of the ruts, a flaw in the countershaft opened out, and of course the engine was disabled. The flaw was in the ingot steel, and could not be discovered except by applying a breaking strain. A local motor-car tried to tow the steamer, but was not equal to the task. Messrs. Merryweather and Sons, Ltd., made a new crankshaft in a few hours, sent it down and fitted it on the spot, and the engine came home under its own steam.

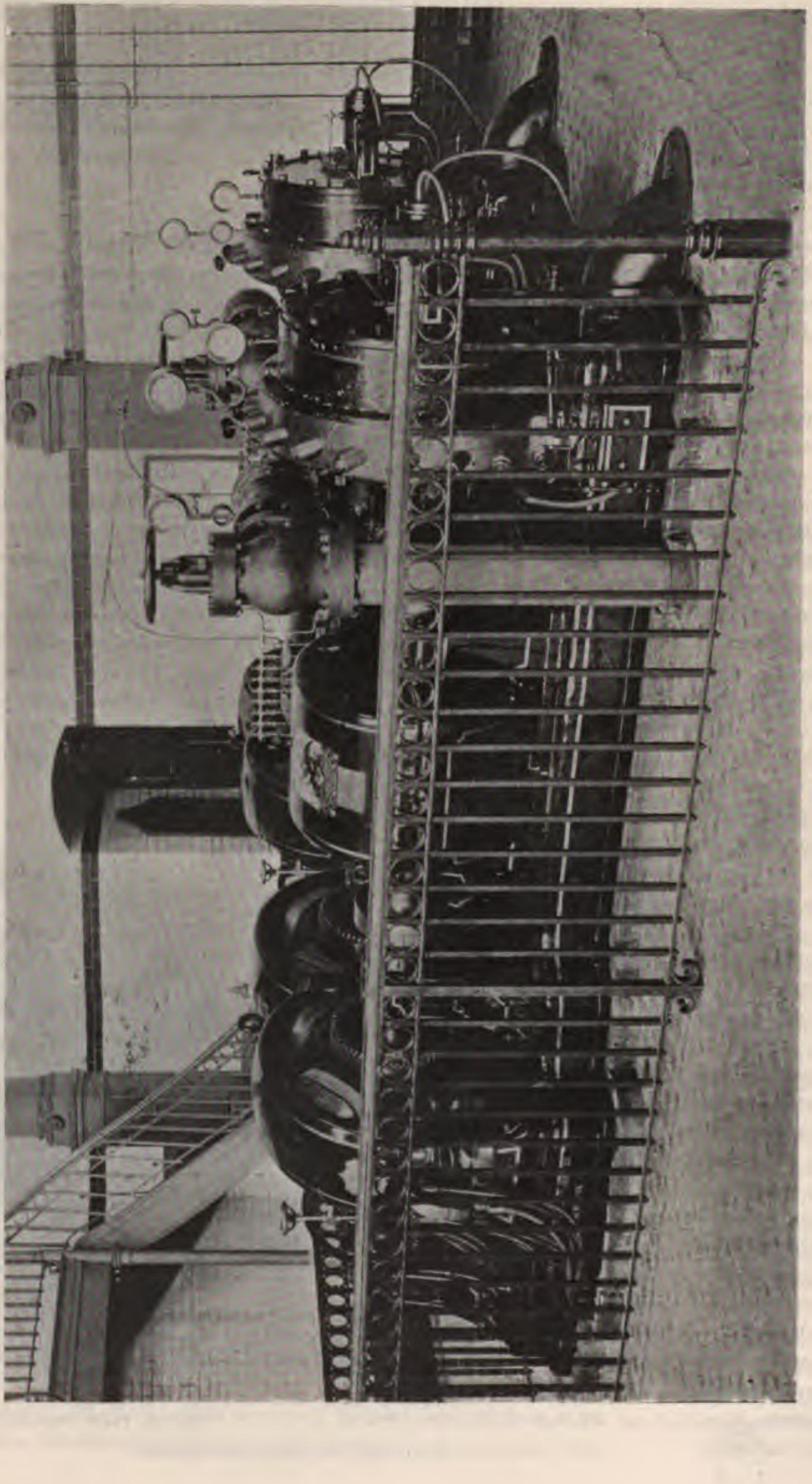
In subsequent trials, we believe, the new steamer has given a highly satisfactory account of itself. It is the most powerful portable steamer in London, delivering 500 gallons per minute. The quick steam-raising water-tube boiler is fired with a new pattern petroleum burner. The machinery, which is placed vertically between the frames in front of the boiler, consists of a pair of inverted steam cylinders, driving two direct and double-acting pumps. The power for propulsion is taken from the crankshaft on this engine by putting a countershaft into gear, from which the road wheels are driven by a pair of steel roller chains running over sprocket wheels. The pump pistons can be disconnected from the engine, or, connected in a few seconds by a simple device, and thus only one set of machinery is required for propelling and pumping, saving a large number of working parts and consequent complications, which have been serious disadvantages in foreign-built motors. The new engine is steered by hand-wheel, with irreversible gear, and is controlled by levers for steam, reverse and brakes. A large hose box is fitted and eight firemen and engineer can be carried. The road wheels are of the artillery pattern, fitted with steel rims, solid rubber tyres, and Parsons' "non-skids." Similar engines are already in use in the fire brigades of Liverpool, Brighton, Portsmouth, Plymouth, Tottenham, Leyland, Heston, and Isleworth and other British towns, as well as abroad.

Turbine Steamer Contracts for the Clyde.

A correspondent of the Glasgow Herald states that it is now pretty certain that two of the new steamers for the Great Western Railway Company will be built by Messrs. John Brown and Co., Ltd., Clydebank, and the other one by Messrs. Cammel, Laird, and Co., of Birkenhead. These vessels are to be a little larger than Professor Bile's turbine steamers for the Midland Company, and will be fitted with a corresponding system of compound turbines, the speed in service between Milford and Rosslare on the Irish coast being 22 knots. This is the first Channel steamer with turbine machinery undertaken by the Clydebank firm, but few, if any, firms are so well able to ensure success in view of the extensive experiments carried out in connection with the two new Cunard vessels. In fact, Clydebank has been doing a great service to engineering in connection with these experiments, as they will show the way out of difficulties in recent turbine installations.



NEW MOTOR FIRE ENGINE FOR THE LONDON FIRE BRIGADE.
Delivery, 500 gallons per minute.



RECENT TURBINE INSTALLATIONS (V.)—DE LAVAL STEAM TURBINES, FORMING PART OF THE POWER PLANT OF THE ANHEUSER-BUSCH BREWING ASSOCIATION AT ST. LOUIS.

Recent Turbine Installations.

V.—DE LAVAL TURBINES FOR A BREWERY POWER PLANT.

The electric generating plant and refrigerating machinery of the Anheuser-Busch Brewing Association at St. Louis, are located in one building. The boiler house, which contains a battery of eleven 500 h.p. water-tube boilers, is about 500 ft. from the engine room. There are three main steam lines to the power and refrigerating plant, one 18-in., one 14-in., and one 12-in. line.

The electric power plant consists of two 750-h.p. vertical type compound Corliss condensing engines, built in 1901. These engines have 21-in. and 42-in. cylinders and a stroke of 48 in. Steam pressure is 140 lb. and speed 90 revolutions per minute. They are direct connected to 500-kilowatt general electric 240-volt direct current generators. These, with two 200-kilowatt De Laval steam turbine dynamos, give a total normal capacity of 1,400 kilowatts.

The two 300-boiler h.p. turbines are of the standard De Laval type, each direct connected to a pair of 200 kilowatt, 240-volt direct current Bullock generators, and operate under 140 lb. steam pressure and a vacuum of 27 in.

The steam guarantees given by the De Laval Steam Turbine Company in connection with these machines were as follows :—

Full load, 17·9 lb. or dry steam per b.h.p. per hour.
Half load, 20·1 lb. of dry steam per b.h.p. per hour.
Quarter load 24·9 lb. of dry steam per b.h.p. per hour.

These guarantees were for 140 lb. steam pressure and 26 in. vacuum.

The normal requirements of the plant are sufficient to keep one engine and one turbine fully loaded, thereby making it possible to hold one engine and one turbine in reserve at all times. The exhaust steam from the engines is led into a condenser of 1,500-h.p. capacity. Condensing water from the cooling towers is circulated through the condenser by a 10-in. centrifugal pump driven by a 50 h.p. Bullock direct current motor. The condensed steam and air are removed together by means of an Edwards triplex wet vacuum pump driven by a 10-h.p. Bullock motor, whose speed may be varied by means of a multiple voltage system.

The condensing apparatus for the steam turbines is a duplicate of that installed for the compound engines, with the exception of the circulating pump, which is an 8-in. centrifugal built by the Kingsford Foundry and Machine Works. Each exhaust line is provided with a 24-in. relief valve, which opens to the atmosphere. Cochrane separators are installed in the steam lines and numerous traps drain the piping, separators, and turbine steam chambers. The oil from engines is drained into a filter and then pumped by means of an automatic oiling system, to the engines, where it is fed under pressure. The turbine oiling system is independent of the engine drainage, but is essentially the same in its operation.

The greater portion of the load on generators is used in driving motors distributed all over the large brewing plant, for operating automatic malting machinery, bottling machines, elevators, fans, blowers, pumps, and for charging storage batteries used on the electric delivery truck.

This entire plant was designed and erected under the supervision of Mr. Ernest Ruebel, of Ruebel-Schwedtmann-Wells, St. Louis, consulting engineers. The De Laval turbine generators were purchased from the Turbine Engineering Company, New York City and Chicago, as agents for the De Laval Steam Turbine Company.

Engines and turbines are painted a deep red colour and are stripped with gold leaf. An automatic electric elevator is installed for the use of the attendants in going about from the condenser room, which is underneath the turbines, to the floor above, where brine-cooling coils for the refrigerating machinery are located.

SOUTH AFRICAN NOTES.

THE RECORD DIAMOND.

DR. MOLLENGRAFF gives the following interesting description of the record diamond from the Premier Mine: It is a portion of a much larger stone, the original form of which can only be roughly guessed at. Four pieces of this original stone have been broken off along cleavage planes, which we know to have the position of octahedral planes. Each of these fragments must have been of considerable size. Consequently, the stone itself shows only a portion of its original natural surface (called "nyf" in the diamond-cutter's jargon), the greater portion being formed by these four flat cleavage planes. The remaining part of the surface shows one octahedral face and a curved irregular surface roughly corresponding to six faces of the dodecahedron, while one very irregular face of the hexahedron is indicated by quadrilateral impressions which are characteristic of these faces in minerals, such as the diamond, which possess the octahedral mode of growth. The stone is a single crystal, no twinning planes or twinning lamellæ being present. The stone is quite colourless, its perfect transparency being best compared to that of pure ice or of the variety of silica known as hyalite. There are a few grains (inclusions) and also some flaws or internal cleavage planes—"glessen" as the diamond-cutters call them—in it, but their position is such that they do not detract from the value of the stone as a gem. It is certainly the purest of all the very big stones known.

The question is raised whether there is any likelihood of finding the fragments which have been detached from this stone by cleavage. It is, of course, possible, but nobody can say whether or where they will be found in the mine. Diamonds are formed at very great depths from carbon dissolved in the molten basic igneous rock (blue ground), from which under the conditions of enormous pressure and very high temperature which prevail at these depths, the carbon crystallises out in the form of diamond. During the period of eruption the diamonds were carried to the surface with great force, and the excessive friction which must have existed in the magma during ejection through the crater pipe, caused the fragments to be cleaved from the original stone. They may have been blown out during the eruption, or they may still be in the diamond-pipe, and may be unearthed at some future time.

EARLY SOUTH AFRICAN DIAMONDS.

At the present time it is interesting to glance at some of the earliest discoveries of diamonds in Cape Colony and the Transvaal. Mr. David Draper recently contributed an instructive paper on this subject to the South African Mines, Commerce and Industries, in which he cites the following from the Queenstown Representative, dated March 3rd, 1871, as showing that diamonds were found in the Transvaal at a very early date: Great excitement was caused here a few days ago by young Joubert bringing in a diamond of 4½ carats which he found on the farm of Mrs. Hennessy, about 2½ miles from here (Pretoria). The Government at once took steps, sent out a commission, Broderick, Lys, Skinner (the two former lately from the diamond fields) and their report is of such a nature that I have no doubt that in a week there will be quite a crowd at the new diggings. Piet Marais and H. Struben have taken a lease of part of the farm, and will commence operations at once. Several farmers have found diamonds on the banks of the Elands River. Two diamonds have been found at Zoutpansberg the Government has sent for them to be tested here—expected next week. In 1870 a diamond was found at Rustenburg. It was valued at £150. These finds, however, were not considered as of much account.

A DISCOVERY IN 1897.

In 1897 we find Mr. Draper notifying to the members of the Geological Society that a most interesting discovery of a diamondiferous pipe had been made lately in the vicinity of Pretoria. He had the permission of the owners to make public the fact that diamonds had been found in what appeared to be a small volcanic pipe, containing minerals closely resembling those in older known diamond mines. Garnets "carbon," olivine and other minerals associated with the diamond were there in abundance and eleven diamonds, one weighing sixteen carats, and several smaller ones had been found in washing the blue. The interesting feature regarding this find of diamonds was that it was the first undoubted diamond mine found in the Transvaal, and as it was situated in the quartzites of the Magaliesberg, it was in a geological horizon much older than the Karoo shales of Kimberley, and also than the cave stones wherein the monastery diamond mine was situated.

A CONTENTION DISPELLED.

As to the latest find, Mr. Draper remarks that the discovery of true diamond-bearing pipes of exceptional richness in the Transvaal is now an established fact. The find at the Premier diamond mine is unprecedented in the history of diamond mining in the world. In other ways, the discovery of true diamond-bearing pipes in the Transvaal has had far-reaching effects. The old theory, that diamonds were derived from the carbon extracted by heat, from the carbonaceous shales which surrouned the old craters near Kimberley, has been exploded, and the contention which every Kimberley man maintained so stoutly, "that there were no mines outside of the Kimberley and Jagersfontein areas," has been completely dispelled. Kimberley men held that no "hardbank" could exist as a surface rock, and that consequently the Schuller could not possibly be a diamond mine, but they found out that they had a good deal to learn about diamond mines. Most probably neither the largest nor the richest diamond mine has been discovered in South Africa, and the fabulous yield of the Premier should be a stimulant for further research.

FLOOD PREVENTION AT BLOEMFONTEIN.

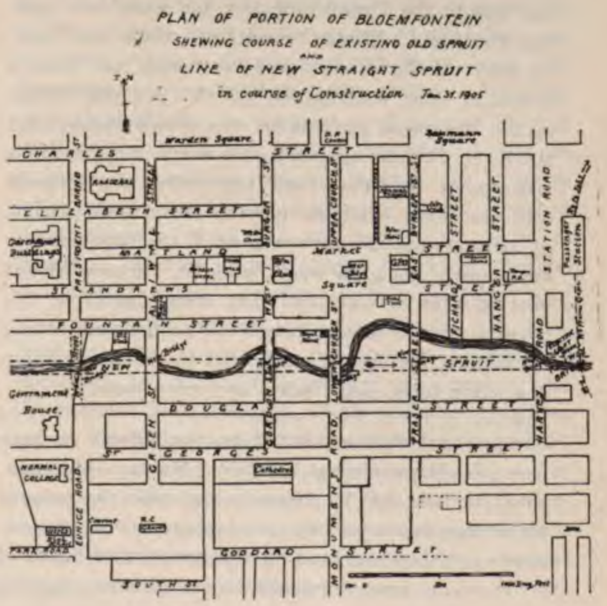
The disastrous flood of January 17th, 1904, will long be remembered by the inhabitants of Bloemfontein. Twenty-six persons were drowned or fatally injured; 95 dwelling houses and other buildings were wrecked or damaged to the extent of £45,000, and the destruction and damage to merchandise, stock, goods and chattels has never been calculated, even approximately. As will be seen on reference to the accompanying plan, when flood water rushed down the old spruit in a raging torrent, it had no time to follow the various sudden bends and twists in its channel, but made a straight cut from point to point with disastrous results to everything in its path.

Floods of various degrees of severity have occurred from time to time in Bloemfontein, projects were discussed for remedying the evil, but nothing was done. The flood of January 17th, 1904, however, recalled the town council and the ratepayers generally to a sense of the danger to the public weal involved in any further neglect of duty, and the council decided to excavate a new straight cut 100 ft. wide at top, 75 ft. wide at bottom, with an average depth of 15 ft., in conformity with plans and sections prepared by Mr. H. F. Peet, Assoc.M.Inst.C.E., the city engineer. The new spruit will be nearly a mile in length—the upper end is not shown on the plan—and there will be six new stone bridges in the positions shown, built of local sandstone of excellent quality.

Tenders were invited in due course, the Transvaal Engineering and Contracting Company, Ltd., formerly known as Pauling Bros., being the successful competitors. They undertook to do the whole of the works, including bridges, for £54,267 5s. 5d., within twelve months from date of order to commence. The works were commenced on October 6th, 1904, and on December 31st, 1904, the contractors had already executed more than one-third of the excavation.

Strenuous efforts were made to get a straight cut through on the line of the new spruit before the rainy season commenced, of a sectional area at least equal to that of the old spruit. These efforts were happily successful. By a singular coincidence, on January 17th, 1905, there was a heavy rainfall of 1·60 in. in about one hour, but the greatest depth of water in the new cut was only 5 ft. 6 in. and no damage of any kind occurred.

To give an idea of the force of the flood of January 17th, 1904, it may be mentioned that two steel bridges each having a floor space of 40 ft. by 20 ft. were washed away bodily. The Harvey Road bridge was carried by the flood through the railway bridge and dumped about 200 ft. lower down the stream. The depth of water at the railway bridge which has a waterway of 50 ft. only, was 21 ft. 3 in. The Fraser Street bridge met with a similar fate. The engine room of the Electric Lighting Works was flooded and the city plunged into darkness for several nights. The railway bridge dammed back the water to a height of 8 ft. It is intended by the city engineer that the new railway bridge shall have a waterway of 100 ft.



TECHNICAL SOCIETY NOTES.

THE paper which Professor David Capper presents to the Institution of Mechanical Engineers to-night is an important one. The "First Report to the Steam Engine Research Committee"—so the title runs—scarcely conveys an idea of the amount of work which it covers. For what has actually been achieved during the trials at King's College, one must wait until the paper has been read, but it is common knowledge that it relates to trials extending over a period of several years and it is believed that the report will be the more exhaustive and complete than any which have preceded it.

It was an interesting discourse with which Mr. William Frecheville, the newly-elected president of the Institution of Mining and Metallurgy opened his year of office yesterday. Mr. Frecheville drew on the rich storehouse of his memory and spoke of experiences in many lands and under very varied conditions. Gold and copper mining are perhaps Mr. Frecheville's strongest points, although he speaks with authority on all that appertains to mining engineering. The concluding portion of his address dealt with the aims and objects of the Institution of Mining and Metallurgy. A full report of the presidential address will appear next week. The new vice-presidents of the institution are Mr. Charles J. Alford and Mr. Edgar Taylor.

One of the most interesting papers which has been read before the Faraday Society for some time past was that on "Electric Smelting," which has been reported in the present and last issue of PAGE'S WEEKLY. The contribution of M. Adolphe Minet to the discussion appears in the present issue, and Mr. B. H. Thwaite also took part in it. Mr. Thwaite's main point was that both the Keller and Héroult processes were available for the useful employment of the power producing resources of the blast furnace now mostly going to waste, and Mr. Bertram Blount insisted that it was time that steel makers in this country decided to adopt electrical methods of working for making the special steels used in the construction of cutting tools, guns, safes, and motor-cars.

Additional figures relating to the Heroult furnace were available through Mr. W. Murray Morrison, who pointed out M. Héroult had recently reduced his energy figure to 0·15 e.h.p.-years per ton of steel, starting with scrap, and to the remarkable figure of 0·0114 e.h.p.-years (equivalent to 2s. 4d. a ton), starting with molten metal; he was now constructing a 300-ton mixer and a 50-ton furnace, from which still better results were to be hoped for. He added that the Keller and Héroult seemed at present the only practicable furnaces as far as this country was concerned, and Mr. R. S. Hutton drew attention to the fact that one of the advantages of the Héroult furnace was due to the fact that it was an arc as well as a resistance furnace.

A good deal of interest was shown concerning the figure of £10 per e.h.p.-year quoted by Mr. Harbord in his paper as the probable price of power. Mr. R. L. Gamlen was of opinion that this was an excessive figure, and that the big power supply companies would have no difficulty in improving upon that. Professor Wilson agreed with Mr. Gamlen that a lower figure could be quoted. Subsequent speakers called attention with not a little bitterness to the conservative attitude of British steel makers, who would not spend a £10 note on an experiment which might put £5,000 into their pockets. This, however, is the opinion of extremists.

An interesting piece of intelligence is that relating to the proposed amalgamation of the Society of Arts and the London Institution. The want of the former has been that it has no building of its own, being simply a tenant at its house in the Adelphi. On the other hand, the London Institution possesses large freehold premises in Finsbury Circus, the only objection to which is that with the City now entirely given up to business pursuits, the geographical position is at fault. The idea underlying the amalgamation appears to be that the London Institution should dispose of its valuable freehold and that adding its funds to those of the Society of Arts, the new corporation should build a new house in the West End, or at least within reach of it; perhaps, indeed, on the site that, but for Mr. John Burns, was to have been given up to Parisian vanities.

The terms of the amalgamation are practically settled. On the Committee which is dealing with the subject, the Society of Arts is represented by, it is understood, the Lord Chief-Justice, Sir Wm. Preece, Sir Owen Roberts, Sir John Wolfe-Barry, and Sir Henry Trueman Wood; and the London Institution by Dr. W. H. S. Aubrey, Major Travers, and Messrs. F. Hovenden, C. F. J. Jennings, W. T. Shaw, and Robert W. Frazer.

TEMPERATURE EXPERIMENTS.

At the last meeting of the Institution of Electrical Engineers on March 9th, Mr. Alex Siemens (president), in the chair, Mr. E. H. Rayner submitted a paper communicated by Dr. R. T. Glazebrook, F.R.S., reporting on temperature experiments carried out at the National Physical Laboratory. The first investigation was as to the effect of heat on the electrical and mechanical properties of such insulating materials as are usually employed in electrical machinery, more especially in the construction of continuous current dynamos and transformers. The second part deals with the internal temperatures of field coils of continuous current machinery. The research in the first investigation involved the determination of the voltage which would pierce the substance, and tests devised to measure the loss of mechanical strength and brittleness. Mr. Rayner exhibited apparatus used in the experiments and gave some practical illustrations of its use.

DR. GLAZEBROOK ON RESULTS ACHIEVED.

Dr. Glazebrook said the report presented was the outcome of a combination of the resources of the National Physical Laboratory and that of the leading manufacturers who supplied the materials for testing purposes. The object of the experiments was to define as clearly as possible the manner in which the temperature rose in machines of various patterns under working conditions. The first question was the determination of the highest temperature that the materials ordinarily employed in electrical machinery could be allowed to reach, and what were the conditions those materials would be under at these high temperatures. Did the strength of the materials increase under such conditions, and if so up to what temperature? It was clear the brittleness of the materials used increased as the temperature rose, but the problem was at what point the brittleness increased to a degree which was dangerous. The mechanical tests were not difficult to devise and carry out. Mr. Rayner had explained the methods which were used in making various experiments and had stated the results.

Taking the matter quite generally it would appear that the properties of the materials tested were somewhat improved by heating up to 75 deg. C., although perhaps, the resistance to punching and brittleness was not always improved up to that temperature. Even up to a temperature of 100 deg. C., the dielectric strength of the materials improved, and the mechanical properties were not seriously affected, but at the higher temperature of 125 deg. and 130 deg. C. weakness began to manifest itself. He might point out that these results had been confirmed by a similar series of experiments undertaken by Messrs. Crompton, and as far as he had seen the results, by another series undertaken by Messrs. Siemens. The trend of all these experiments was to show that up to a temperature of 100 or 110 C., or even perhaps a little higher, the materials which were likely to be used in field coils did not in practice show any such sign of deterioration as might condemn them from use. These, however, were matters to be discussed by members of the Institution with more practical experience than himself.

COTTON AS AN INSULATOR.

One very interesting fact brought out by one of Mr. Rayner's experiments was the way in which the temperature of the cotton and all other insulated materials changed as the moisture was dried out, and there was one particularly striking point to which attention might be directed. When cotton had been treated for some appreciable time and kept at that high temperature, and then was suddenly allowed to cool, there was a very large sudden rise of resistance. Reference was made in the paper to that fact and the way in which the moisture was drawn back into the pores of the material on sudden cooling. Assuming it to be shown by the experiments detailed in the first part of the paper that such temperatures might be allowed in machines without damage, the question arose as to what temperatures were actually reached in machines at work. It was possible, of course, to measure external temperatures by thermometers, and even then large variations could be got by varying the mode of packing the thermometer. It was possible also to measure the average temperature internally by means of the change of resistance, and he thought that the very simple portable apparatus which Mr. Rayner had devised made it easy to measure such temperatures within a reasonable degree of accuracy. The measurement of the average temperature was not, however, sufficient because it was clear that the temperature at one part of the coil might exceed the average temperature by a very considerable, and by a varying amount. The experiments made by Mr. Brown years before had shown that it was just a question whether sufficient variety had been made in researches of this character, and it was considered that it might perhaps be advisable to repeat the experiments with a little modification on a series of coils of various sizes and pattern. He would like to refer to the valuable assistance received from the various manufacturers, the work done really being, as he had stated at the outset, a combination of the resources of the National Physical Laboratory and the manufacturing side of the industry. The coil was first tested at the laboratory to see what the distribution of temperature would be when not on the machines, and then afterwards tested in the maker's works. The work was carried out at the suggestion of the Engineering Standards Committee and the thanks of the Institution were due to that Committee for the help given. He was ready to hear suggestions as to carrying the work further.

The discussion was adjourned.

PRIME MOVERS AND MODERN POWER GENERATION.

At a meeting of the Leeds Association of Engineers, the President occupying the chair, Mr. J. T. Pullon read a paper on "Prime Movers and Modern Power Generation."

Steam engines, said the author, were the most important of our prime movers; modern improvements being not so much in the engines and boilers as in the numerous auxiliaries. Considerable economy in boiler feeding was effected by Halpin's thermal storage vessels, placed above the boiler through which the feed is passed. Unwin's test gave an economy of 20 per cent., and Mr. Ivatt had recently applied one over the barrel of a Great Northern locomotive. With colliery winding engines using 4 to 5 tons of steam per hour and rolling mill engines using 20 tons, M. Rateau had effected a great saving by collecting the exhaust steam in thermal storage vessels for use in driving low-pressure steam dynamos and working with a 25-in. or 26-in. vacuum. Further economy lay in the direction of superheating. The thermo-dynamic gain was only a small one, the index of expansion of superheated steam being 1·3 as against 1·03 for saturated steam, the work done being proportionately less and heat was necessary for superheating. The economy was therefore not directly due to superheating but to prevention of loss due to initial condensation, leakage, etc. The maximum efficiency of boilers reported up to date was 83 per cent. but was often as low as 65 per cent.

Internal combustion engines were also passed under review, Mr. Pullon alluding to the effect of Thwaite gas as compared with other gases rich in hydrogen in giving a better and larger turning moment on the crankshaft with much less strain and shock on the bearings. This was illustrated by three combined diagrams. A 400 h.p. gas-cleaning plant would be at work on this system in Leeds in a few weeks.

THE TRAMWAYS AND LIGHT RAILWAYS ASSOCIATION.

The official circular for March, 1905, contains a notice of a proposed visit to the Metropolitan Electric Tramways on Thursday, March 30th; and of Mr. G. A. Trube's lectures on "Brakes." A full report of the annual meeting, on February, 10th is given, and of Mr. Herbert Jones's lecture on the Waterloo and City Railway (with diagrams), with the discussion thereon, on February 23rd. The visit to the London United Tramways is fully described. The correspondence on the limits of speed in the case of tramways with the Board of Trade, and their latest memorandum on details of construction and equipment, are also given.

The report for the year ending December 31st, 1904, of the Institution of Mining and Metallurgy, states that during the year the membership has increased by 134, the total number of members being 1,246. The report states that the council look for an early decision in regard to the reorganisation of the Royal School of Mines. A committee has been appointed with the object of standardising mining and metallurgical weights, measures, terms, etc. The income of the year at £4,135 showed an increase of £945.

At the last meeting of the Glasgow Students' Association of the Institution of Civil Engineers, Mr. J. E. Harrison, M.Inst.C.E., president of the association, presiding, Mr. Thomas Lees, jun., Stud. Inst.C.E., read a paper on "Permanent Way." He discussed the important features in the construction of permanent ways in modern railroad practice, and compared them with the methods adopted abroad. A short historical sketch was given showing how the modern railway track had developed from the old wooden tracks of earlier times. The permanent way proper was then dealt with, and the practice of British railway companies compared with American methods. In conclusion, a plea was made for supported joints in preference to suspended joints. An animated discussion followed.

NAVAL NOTES.

WEEKLY NOTES ON NAVAL PROGRESS IN CONSTRUCTION AND ARMAMENT.

(BY OUR NAVAL CORRESPONDENT.)

GREAT BRITAIN.

THE Clyde shipbuilders are having a busy time just now, as four of the armoured cruisers of the *County* class are either ready for their trials, or have already entered upon them. The *Carnarvon* also, which has been built by Beardmore, has completed her trials and attained a full power speed of 23·3 knots, as against the 22·25 designed.

The following table gives the results of the trials:—

	At ⅕ power.	At ⅘ power.	At full power.
Speed, knots ..	14·3	21·43	23·3
I.H.P.	4,756	15,212	21,489
Revolutions ..	84·3	128·7	142·1
Steam pressure, lb...	184	—	202
Coal consumption, lb.	2·11	—	2·28

The *Argyll* also is in dry dock preparing for her trials, and the *Roxburgh* and *Antrim* should also shortly be at sea for the same purpose. It is expected that the *Carnarvon* will be commissioned in about six weeks' time.

Approximate dates for the launching of the *Africa* and the *Hibernia* have been announced, and from these it is likely that the *Africa* will be off the stocks towards the end of May, and the *Hibernia* on or about June 6th. These two vessels were laid down within a few days of each other and the progress made with them has therefore been at a fairly uniform rate.

FRANCE.

There is still some doubt as to the ultimate decision of the Minister of Marine on the subject of the armoured cruisers *Edgard Quinet*, *Ernest Renan* and *Waldeck Rousseau* (C. 17). It had been intended to make the *Edgard Quinet* a vessel of 23 knots speed and the other two of 24 knots and larger displacement. Homogeneity, however, is one of the attributes M. Thomson desires to introduce into the French navy, and for that reason he has called for estimates as to the cost of altering the *Edgard Quinet* to conform with the lines of the *Ernest Renan*. If the pecuniary loss entailed is not too heavy it is quite probable that the alterations will be effected.

GERMANY.

The discussions on the German navy estimates were a trifle acrimonious and in the end the original amount of the estimates £11,610,000 (M.232,200,000), was reduced by £159,000 (M.3,198,000). The total number of men voted was 36,622.

RUSSIA.

The fate of the three small battleships built by the Terni Trust as a speculation has now apparently been settled by the purchase of them by Russia. They cannot, of course, be delivered until the war is ended, but they will then do something to balance the *Kashima* and *Katori* which are building in this country for Japan. The fact of the sale of the three vessels (which it was once understood were for the Italian navy) has been kept very secret, and it does not appear that any official announcement of the transaction is to be expected while the war continues.

The state of Rozhdestvenski's squadron must be very bad by now, and the report that the bottoms of the vessels are so foul that they can hardly move through the water is by no means improbable. Three months lying idle in the waters around Madagascar is not the best way to keep a battle squadron up to the fighting and manœuvring efficiency required to meet an enemy like Togo.

UNITED STATES.

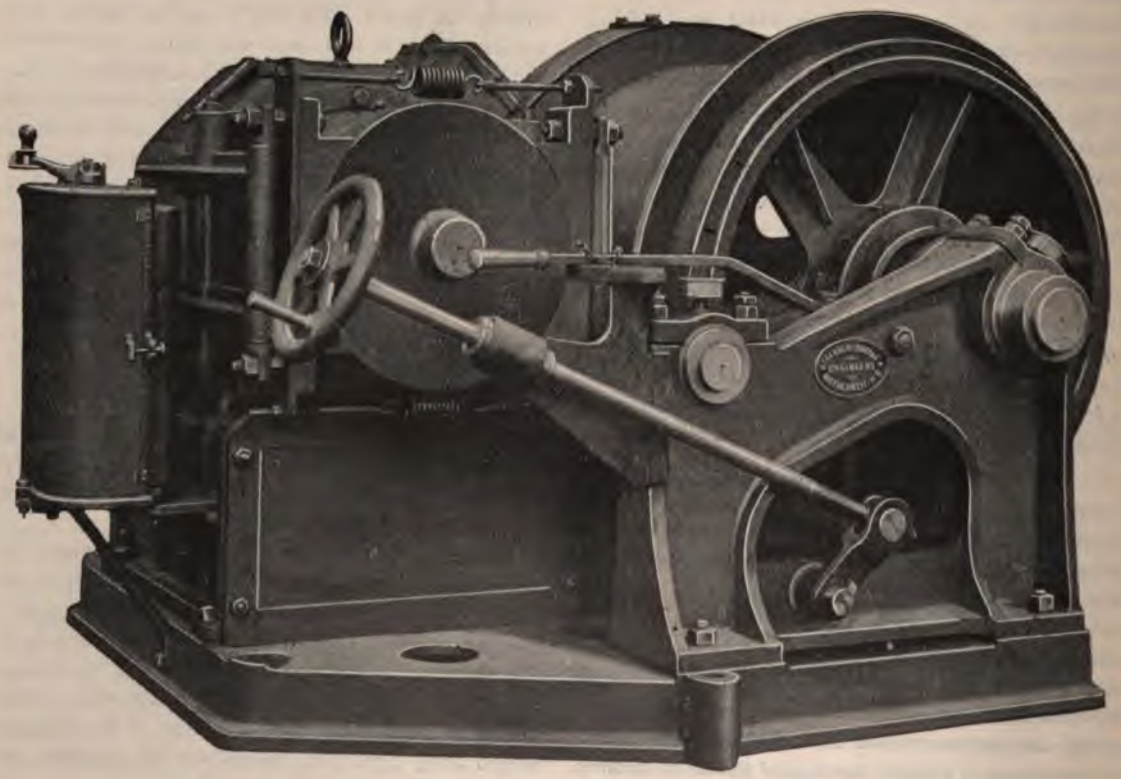
The Senate has passed the Naval Appropriation Bill practically in its entirety, and the United States programme for the ensuing year therefore comprises two battleships and some smaller vessels.

Tenders have been called for for three "scouts" of 3,750 tons displacement. The general dimensions of these vessels are: Length, 420 ft.; beam, 46½ ft.; draught, 16¾ ft. The maximum coal capacity is to be 1,250 tons and the engines are to develop 16,000 h.p., but the American papers fail to state what speed will be required. The engines will be of the ordinary reciprocating type and steam will be supplied by twelve boilers of the *Express* type.

AN ELECTRIC HAULING WINCH.

BY MESSRS. CHAMBERS, SCOTT AND COMPANY, MOTHERWELL, N.B.

THE accompanying illustration represents the latest type of electric hauling winch for outside service manufactured by Messrs. Chambers, Scott and Company, of Motherwell, N.B. It is of compact design, and strong construction, and is arranged so as to permit of easy overhauling when necessary. The gear is powerful, exerting a pull of two tons on the winding rope at a speed of 120 ft. per minute. A magnetic and mechanical brake and clutch gear are fitted to the winch. This arrangement allows the gear when winding to be braked automatically as required, and enables the load to be run out under perfect control of the screw brake, all the levers, etc., being conveniently arranged for the operator at the rear of the winch. The drum is 3 ft. in diameter, built of steel with cast-iron flanges, and runs loosely on its shaft, to which it can be fixed by means of a clutch actuated by a hand lever. It is equipped with a wood-lined brake, operated by screw and handwheel, and the gear is of cast steel, the first reduction gear being machine-cut. The motor is of the enclosed type, fitted with a self-sustaining magnetic brake and raw-hide pinion, and is controlled by a reversing and speed-regulating switch of the tramway type, furnished with a metallic resistance in a cast-iron box forming a seat for the motor. The gearing is protected by built steel covers and guards, whilst the electrical equipment is all encased. All the gear, etc., is mounted on a sole plate, and the bearings are fitted with gun-metal bushes and adjustable covers and lubricators. The winch illustrated, which has been supplied to a large shipbuilding yard, will haul trucks loaded to sixty tons at the rate of two miles an hour on a level track.



NEW ELECTRIC HAULING-WINCH FOR OUTSIDE SERVICE.

HEAVY EXPRESS LOCOMOTIVE DESIGN.

By J. R. BAZIN.

ONE of the chief points to be aimed at in designing a locomotive for working heavy express trains is to plan it in such a manner that its power can be exerted uniformly throughout the journey; that is to say, its speed, when once fairly started with its train, should never fall below 53 miles per hour when ascending banks, and rarely exceed 70 miles per hour in running down hill.

TWO PREVALENT TYPES.

The two classes which are becoming most prevalent are the "10-wheel" and the "Atlantic" type. Comparing the "10-wheel" type with the "Atlantic" type, the former is unquestionably better adapted for working over a road with many steep gradients on account of its greater adhesive power, but the third-coupled axle undoubtedly must hinder the running of the engine at high speeds, causing a great deal of extra wear and tear to the machine and increasing the internal resistance; and it is very doubtful whether the extra seventeen tons or so available for adhesion is really an advantage with the size of cylinders found to be the most satisfactory for such engines when employed on straightforward express work. The "Atlantic" type possesses one distinct advantage over the "10 wheel" type, as it has all the coupled axles placed in front of the firebox, and so enables the firebox to overlap the frames, thus allowing it to be made as wide as the loading gauge will permit, and increasing the grate area to a large extent; and instead of having a long narrow box, a short broad box can be employed, giving greater facilities for firing, also enabling a larger water-space to be left between the inside box and outside shell, a most important feature in boiler design, which not only allows of freer circulation, but also gives greater facilities for getting the scale and dirt out of the boiler. In this type of engine there is far greater scope for increasing the size of the firebox than is possible in any other design where the firebox has to be between the frame.

It has been stated above that the capacity of the boiler as a steam generator is the real source of reserve energy in the locomotive, and it is chiefly on account of the facilities offered for increasing the size of the boiler that the "Atlantic" type has been shown as preferable for main line work; but other important features which play equally as great a part in producing an efficient engine must not be overlooked, viz., the number, arrangement, and size of the cylinders, the diameter of the driving wheels, and the working pressure of the boiler.

DIVIDING THE ENGINE.

It is impossible to allude to the number and arrangement of the cylinders without touching on the much-disputed question of the advisability of compounding; and it may here be safely stated, as far as this country and America are concerned, that whatever has been achieved by the compound locomotive has been done by the simple engine. With the compound engine, when working hard, the most effective point of cut off in the high pressure cylinders is about 55 per cent, of the stroke, whereas in the simple engine steam is cut off at 25 per cent.; thus it is doubtful whether the amount of steam used in the compound is much less than that used in a simple engine of equivalent cylinder power. It is not intended here to discuss the various kinds of compound locomotives in use, but it is sufficient to say that the four-cylinder de Glehn engine has proved by far the most satisfactory of modern compounds. The success of the compound engine being chiefly due to its high boiler pressure, and since the use of such high pressures entails so many drawbacks, it is well to consider if the advantages claimed for compounding are really worth the extra wear and tear that the boiler is subjected to. With regard to the advisability of dividing the engine, that is a point which suggests a great opening for development in the steam locomotive; for since the objections to compounding have been briefly stated, there is no reason to prevent the system of dividing the engine being carried out in the simple locomotive. In such a design, as large a boiler as possible with the most efficient steam generating capacity would have to be provided, for which the "Atlantic" engine adapts itself admirably; and instead of using a high working pressure of about 225 lb. per square inch, as in the case of the compounds, a lower pressure of 180 lb. per square inch would give most satisfactory results.

In the case where four cylinders were employed, one pair would be placed outside and the other pair inside the frames, and could be arranged in two ways—either all driving on the front-coupled axle with the four cranks at right angles, so that those of the inside and outside cylinders on the same side would be at 180 deg., thus making the reciprocating parts balance each other; or the two inside the frames could drive the front-coupled axle, and the other two outside the frames could drive on the rear coupled-axle. This latter method would perhaps distribute more evenly the stresses and strains without altering the balancing if the cranks were arranged as above.

If three cylinders were used, the most satisfactory method of placing them would be for one to be inside and two outside the frames, all driving on the leading coupled axle with the cranks at 120 deg. This arrangement would give a better turning moment than the four-cylinder method, and allow the engine to start easier, but the balancing would not be so well maintained.

SIZE OF CYLINDERS.

The next point to be decided is that of the best size of cylinders to be employed, and on examining the various types of express engines running at the present time it is found impossible to lay down a definite rule with regard to this point, as it is found that while some engineers employ cylinders up to 20 in. and 21 in. in diameter, others use 18 in. and 19 in. cylinders on similar work, with apparently equal success.

Passing from the question of the diameter of the cylinders, the part the stroke plays is of equal importance. Now the shorter the stroke the lower the piston speed and the less the back-pressure, but the longer the stroke the more room there is for the expansion of the steam and the greater the amount of leverage on the crank-shaft; but with a long stroke the back pressure to be overcome amounts to a considerable factor in increasing the internal resistance of the engine at high speeds, and it is found in practice that it is better to use a stroke of moderate length, say 24 in. or 26 in., and give the cylinder an extra ½ in. or 1 in. diameter to allow for better expansion, than to use a long stroke and small diameter of cylinder or a short stroke and large diameter of cylinder. It may be suggested that two cylinders 19 in. by 24 in. could be employed with satisfaction where the total weight on the coupled axles must not exceed 36 tons, of which, under the most favourable circumstances, rarely more than one-fourth would be available for haulage purposes; and both the steam and exhaust ways should be of ample dimensions to allow as great a head of steam to enter the cylinders as possible, and also to be got rid of quickly after having done its work. If, now, those two cylinders be split into four smaller ones, in order to obtain the same piston area as that given by the two 19 in. cylinders, he size of the smaller ones must be about 13½ in. in diameter; but since, with well-designed steam and exhaust ports, the total back-pressure could be reduced, four cylinders of 14 in. diameter could be employed, the stroke of 24 in. remaining the same.

With regard to the diameter of the driving wheels, in ordinary practice the most satisfactory diameter for driving wheels is found to be about 6 ft. 8 in. for fast work, and this size easily allows a boiler of large diameter to be placed above them without necessitating an extremely high centre line.

Having now described that part of the machine which converts the "heat energy" into "mechanical energy," it will be as well to say a few words with regard to the size of the steam generator or boiler for use on such a locomotive. It is in the efficiency of the boiler to generate sufficient steam to keep four such cylinders fully supplied under the most adverse circumstances that the real reserve power of such an engine is found. A boiler for this purpose should possess at least 2,500 square feet of efficient heating surface, of which quite 170 square feet should be given by the firebox, and the grate area should be about 32 square feet. Such a boiler must be at least 5 ft. 6 in. internal diameter, and about 16 ft. in length. This will give room for quite 250 tubes, having an internal diameter of 2¼ in., so as to allow for a relatively slow velocity being imparted to the gases issuing through them from the firebox, thus allowing more heat to be given out by them; also to prevent the possibility of choking taking place. A properly designed boiler of this description should be able to fulfil all that is required of it when working the heavy express trains of the present day.

"ATLANTIC" TYPE BEST FULFILS REQUIREMENTS.

It will thus be seen that the design of engine best suited for dealing with these heavy long-distance express trains is undoubtedly one of the "Atlantic" type having four h.p. cylinders, 14 in. in diameter, with a 24 in. stroke, each pair driving on two separate coupled axles, with driving wheels 6 ft. 8 in. in diameter, and these cylinders supplied with steam from such a boiler as has just been described above, working at a pressure of 180 lb. per square inch. A four-cylinder engine such as this would, in the first place, cost more than a similar two-cylinder engine, but since the wear and tear would be considerably reduced, on account of the better balancing and more even distribution of the stresses and strains, the cost of maintenance and running expenses would be less.

From a paper read on March 13th to the Graduates' Association of the Institution of Mechanical Engineers.

THE UGANDA RAILWAY.

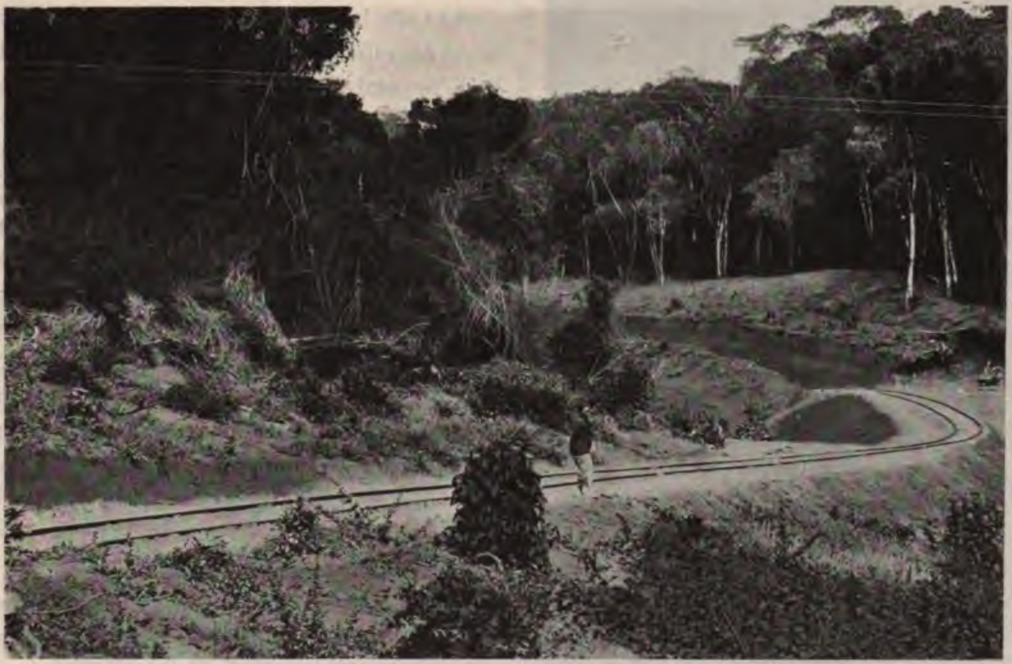
BY J. D. F. LEYLAND.

(*Continued from page 468.*)

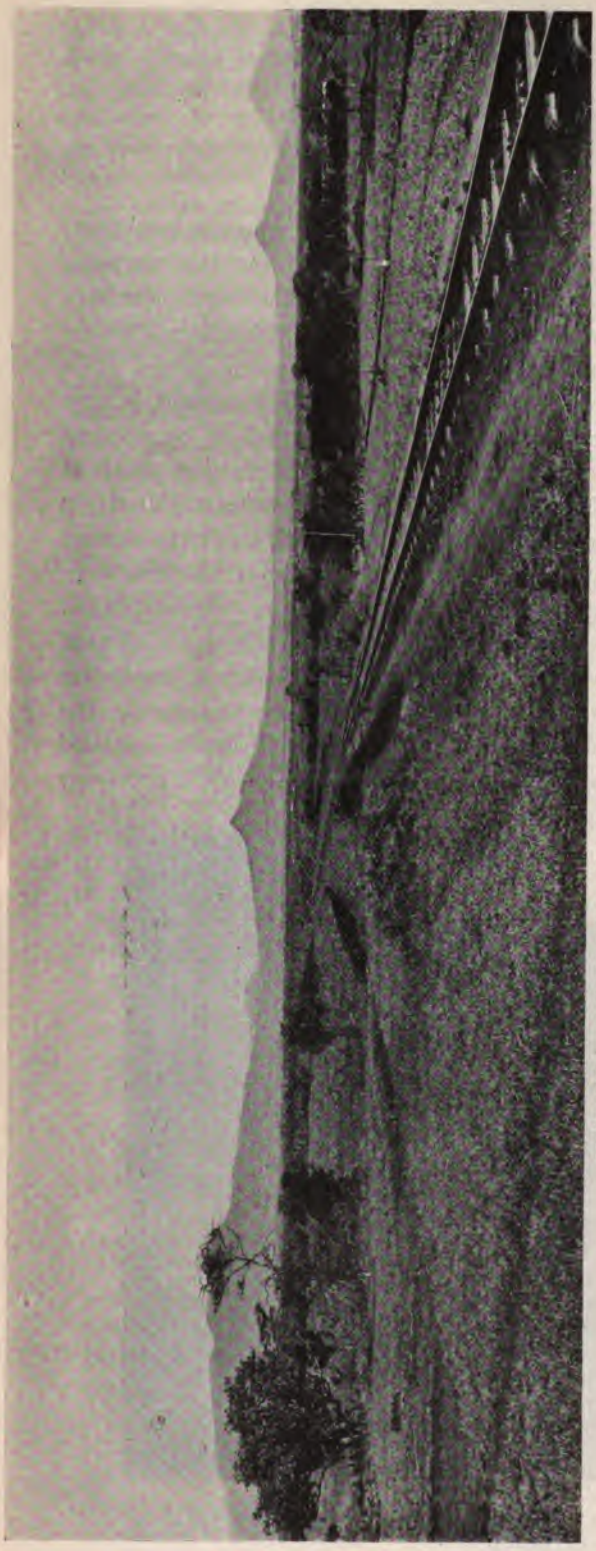
IN addition to the engineering difficulties there were in East Africa many extraneous ones, which may be said to be peculiar to this railway, and few of which were or could have been forseen at the outset.

Sir Guilford Molesworth, in his report, said: "This combination of difficulties is, I think, quite unique in the whole history of railway construction." The making of this railway, on account of no local labour being obtained, involved an organisation equal to the maintenance of an alien army, amounting to about 22,000 men, who had to be sheltered and fed in a practically waterless country, devoid of all resources and all means of animal and wheeled transport, native porters being used for this purpose. Everything had to be ordered a long time beforehand, requiring a great deal of foresight. Fever and "jiggers" infested the coolie camps. The water in the country, as I have said, is very scarce and unwholesome, and it was found necessary to erect large condensing plant at Kilindini, and most of the water required for consumption and boiler work had to be carried by rail from this place. About 120 tons were required per diem for drinking purposes alone.

The first 250 miles of the railway are infested with the tsetse fly, which makes it impossible for transport animals to live in this region. The progress of the work was seriously impeded by man-eating lions, which made it necessary



VIEW AT MILE 485 (TEMPORARY LINE) ILLUSTRATING THE DIFFICULT NATURE OF THE COUNTRY TRAVERSED.



PANORAMIC VIEW OF THE RAILWAY BETWEEN MUHORONI AND KIBIGORI.

to convey all the workmen back to a safe camp every night. No less than twenty-eight coolies, one engineer, and an assistant police superintendent were killed by these savage beasts.

The engineering strike in England seriously impeded work out there, causing innumerable delays in the delivery of materials required for the railway. A police force of two hundred men had to be organised and maintained. An agency for the supply of labour and materials had to be founded and kept up in India. A regular postal and telegraph service had to be established, and very complete hospital arrangements were required. The want of rolling stock and locomotives was the most formidable obstacle to progress. Every train had to carry special water-tank wagons for the use of locomotives, thus limiting its carrying capacity. Officers had to learn two native languages in use on the line.

There were, however, many advantageous conditions which, to a certain extent, counteracted the difficulties. At the river Athi, mile 310, there was found to be a supply of water enough for locomotive purposes. Also at Nairobi, and at the head of the rope incline, there was a good supply of water. Transport animals do well beyond the fly district. Traction engines of military type also proved very useful. The Wa-Kikuyu were induced to clear the jungle in their own districts. The death rate among the coolies was, on an average, 20 per thousand per annum, which, considering the climate and conditions, was remarkably low. The coolie labour obtained from India was fairly good, but very expensive. After passing mile 33, bad nights, such as have to be endured on the tropical coasts of Africa and India, are never experienced. Hospitals were established at Kilindini, Voi, and Makindu, with five medical officers to each.

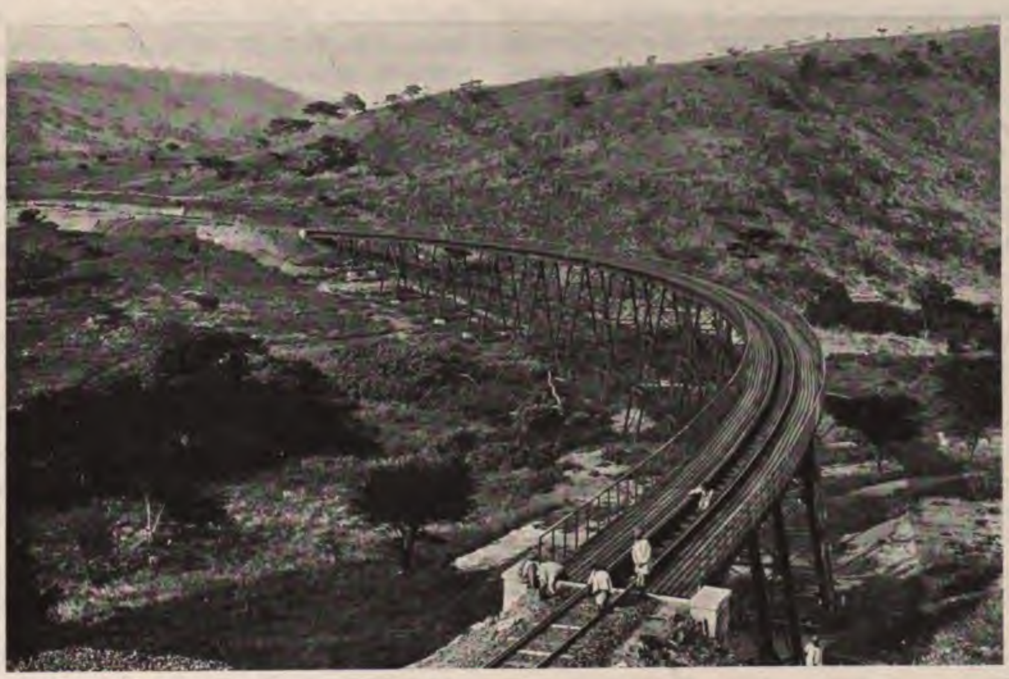
SOME ENGINEERING DETAILS.

The engineering staff was very carefully selected from a large number of candidates; all of them were extremely intelligent, energetic, and with a keen interest in their professional duties. Sir George Whitehouse is a well-known engineer, with long and varied experience in tropical countries, and he has proved his qualities by the great work he has accomplished. The Uganda Railway is a metre-gauge line. A great part of its length is through cuttings and on embankments, with steep gradients and sharp curves. There are about 500 miles of gradient and 150 miles of curves. The whole of the railway is ballasted, but it was thought at first that this would not be necessary throughout its length. The permanent way consists of 50 lb. flat-footed steel rails, carried on pressed steel trough sleepers. On all curves of less than 1,200 ft. radius, ⅝ in. extra gauge is given. The earthworks and bridging on the whole line were completed during last year.

There are thirty-five viaducts, varying in length from 117 ft. to 881 ft., and in depth from 37 ft. to 111 ft. Each viaduct is divided up into spans of 40 ft. and 20 ft., and they are built upon the spider-bridge system. Thirteen firms, three of which were American, tendered for the supply of certain of these viaducts. The contract was given to the American Bridge Company of New York, otherwise known as the Pencoyd Iron Company. This Company contracted to deliver the bridges at any British port at £10 6s. per ton, free on board, or to erect them within forty-six weeks of contract at £18 per ton. The principal workshops and running sheds are at Nairobi; the stores at Kilindini. Engine sheds have been built at Kilindini, Voi, Makindu, Nakuro, Mnara, and Port Florence.

The special conditions prevailing on the railway during construction, added to the necessity of having a large number of locomotives, have been referred to. The total number of engines on the line was about one hundred. The causes of the great number required were the steep gradients, sharp curves, the carrying permanent way material and water, and the great percentage of engines always under repair, or being washed out, which was necessary on account of the character of the water.

The accompanying illustrations are reproduced by the courtesy of the Foreign Office. (*To be continued.*)



VIADUCT AT MILE 531 ON THE UGANDA LINE.

MODERN COMMERCIAL GRINDING.

A PAPER on this subject was read before the Birmingham Association of Mechanical Engineers, the following being an abstract.

The author refers chiefly to plain or taper cylindrical work, as he is of opinion that at the present time it offers more possibilities to the mechanical world than other work for which the grindery machine is used.

The early application of grinding was done chiefly on work which had been previously hardened, and could not be corrected, or brought to size by any other means, and was looked upon as an expensive refinement; but during the last few years the art has so progressed that to-day it is not possible to bring cylindrical pieces to size by any other known method so quickly, and at the same time so accurately, as with the plain cylindrical "Grinding Machine."

Another feature has been the accompanying progress of the manufacture of emery wheels, the machines being but the means of using the emery wheels. It is now known too, that work cannot be ground economically without a copious and constant supply of water.

THE SPEED OF TRAVERSE.

The author deals with the speed of traverse. It is obvious that the capacity of a grinding machine is limited by the width of the emery-wheel face, and if this is kept flat, the maximum output is being obtained from the machine. A large diameter emery wheel will retain its size or wear away less of its diameter than a small one, but if proper attention is paid to the periphery speed of the wheel the difference in size makes so very little difference in time that it can hardly be taken notice of compared with the traverse and speed of the work.

It was formerly considered that only slim work required steadying, and that heavy work, say 6 in. to 12 in. diameter, would resist both the pressure and vibrations set up by the emery wheel. This, in the author's opinion, is a grave mistake, and he seeks to demonstrate that it is in the heavy work where the rest is more essential. This, no doubt, sounds rather revolutionary until an explanation of the phenomena is given. Large pieces of work do not absorb the vibrations so quickly as small diameters, therefore they vibrate longer.

It is possible to grind large work truly circular, and with a good finish, without steady rests; but to be able to accomplish a good result, the work must be first turned, true as to roundness and parallel, and to within 4 or 5 1-1000 in. of the finished size. Nothing but the very lightest cut is possible with the emery wheel under these conditions, therefore the time occupied in working is greater than the present-day manufacturing conditions render desirable.

TURNED WORK NOT SO TRUE AS GROUND WORK.

No work, however carefully turned in the lathe, is so true as ground work, owing to the work in the lathe revolving upon a running centre, and any inaccuracy of revolution, either from the lathe spindle, or from the point of the centres, is multiplied on the work. With the grinding machine this defect is avoided by revolving the work upon centres which do not move, this being considered the best method of securing accuracy. To ensure work being ground concentric steady rests should never be brought to bear on parts which are not being ground, or have not been ground, no matter how apparently true the prepared parts are. To use the grinding machine successfully, one must understand that not only the machine, but the wheel and the work itself have their own part to play, and lack of attention to the two latter factors may cause trouble for which the machine is in no way responsible. The preliminary to successful grinding is a careful study of particular requirements. The wheel best suited for one class of steel would not work successfully on steel of a different carbon. Cast iron of various qualities, and bronze also, require varying treatment. Copper and bronze should be ground with a soft bonded wheel which is also used on such materials as chilled iron hardened steel, cast iron, etc. More heat is often generated on the work than can be radiated equally, thus causing it to run in an eccentric.

To overcome the trouble it is necessary to remove the cause, and if by turning on the water to its extreme limit the trouble does not cease, then a wheel with a softer bond must be tried.

To get good results from an emery wheel it must have a constant periphery speed. The importance of this fact is recognised by the makers of grinding machines, and is provided for by cone pulleys of varying diameters.

The best authorities recognise a periphery speed of 6,000 ft. per minute as being the most desirable. The ideal drive for the grinder is an electric motor, with a machine specially designed to take it; this does away with the trouble experienced by varying loads, and ample power can always be provided.

STRUCTURAL STEEL FOR MARINE BOILERS.

THE latest specification to hand from the Engineering Standards Committee is concerned with structural steel for marine boilers, and is based upon a careful comparison of the present specifications of the Admiralty, the Board of Trade, and the three leading registry societies. The sub-committee dealing with this matter consisted of Mr. Archibald Denny, chairman, Sir John Durston, K.C.B., R.N., Messrs. R. J. Butler, C.B., W. E. Smith, C.B., and P. Samson, Professor W. C. Unwin, Messrs. James Dunn, W. J. Pratten and Arthur Cooper, A. McA. Kennedy, Alexander Gracie, Henry Withy, Summers Hunter, David Colville, F. W. Dick, A. D. Wedgwood, Bernard A. Firth, H. J. Cornish, J. T. Milton, J. Foster King and John Gravell, Sir Benjamin Hingley, Bart., Messrs. William Thackray, William Wylie, J. McIntyre and James McKechnie.

The specification provides that structural steel for marine boilers must be made by the open hearth process, acid or basic, as may be specified, and as approved by the inspecting body. The finished material is to be free from cracks, surface flaws, and lamination. It must also have a workmanlike finish, and must not have been hammer dressed.

Tensile strength and ductility are to be determined from standard test pieces cut lengthwise or crosswise from the rolled material. When material is annealed or otherwise treated before dispatch, the test pieces are to be similarly and simultaneously treated with the material before testing. As regards plates, whereever practicable, the rolled surfaces shall be retained on two opposite sides of the test piece. The elongation is to be measured on a standard test piece having a gauge length of 8 in.

For material more than ·875 in. in thickness the width of the test piece between the gauge points must not exceed 1½ in.; for material ·875 in. to ·375 in. in thickness, inclusive, the width is not to exceed 2 in.; for material less than ·375 in. in thickness the width must not be more than 2½ in. In other respects the test pieces is to conform generally to the standard test piece A reproduced herewith.

For round bars the test piece must have a gauge length of not less than eight times the diameter, and a sectional area of not less than ¼ square inch. When enlarged ends are used the length of the parallel portion must be not less than nine times the reduced diameter.

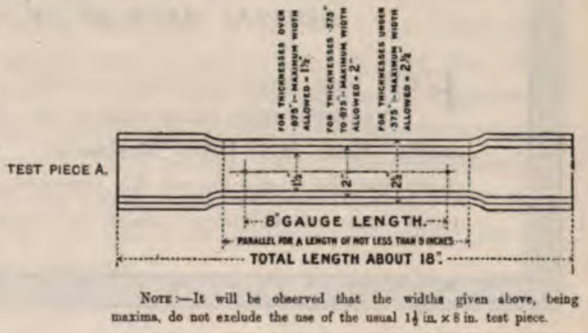
The tensile breaking strength of steel plates for shells and girders, determined from standard test pieces, are to be between the limits of 28 and 32 tons per square inch. For plates intended for flanging or welding, and for combustion chambers and furnaces, the tensile breaking strength must be between the limits of 26 and 30 tons per square inch. In the case of material for purposes in which tensile strength is not important, the tensile test may be dispensed with and the bend test only made, if so specified and approved. The elongation, measured on a standard test piece having a gauge length of 8 in., is to be not less than 20 per cent. for material of ·375 in. in thickness and upwards required to have a tensile breaking strength of 28 to 32 tons per square inch; and not less than 23 per cent. for material of ·375 in. in thickness and upwards required to have a tensile breaking strength of 26 to 30 tons per square inch.

The tensile breaking strength of longitudinal stays and angle and tee bars is to be between the limits of 28 and 32 tons per square inch, with an elongation of not less than 20 per cent. measured on the standard test piece. For bars for combustion chamber stays the tensile breaking strength shall be between 26 and 30 tons per square inch, with an elongation of not less than 23 per cent. measured on the standard test piece.

For material under ·375 in. in thickness the elongation may not be more than 3 per cent, below the abovenamed elongations. The tensile breaking strength of rivet bars are to be between the limits of 26 and 30 tons per square inch of section, with an elongation of not less than 25 per cent. measured on the standard test piece.

TEST PIECE A.

FOR PLATES AND OTHER STRUCTURAL MATERIAL.


FOR THICKNESSES OVER ·875"—MAXIMUM WIDTH ALLOWED = 1½"
FOR THICKNESSES ·375" TO ·875"—MAXIMUM WIDTH ALLOWED = 2"
FOR THICKNESSES UNDER ·375"—MAXIMUM WIDTH ALLOWED = 2½"
TEST PIECE A.
1½"
2"
2½"
8" GAUGE LENGTH.
PARALLEL FOR A LENGTH OF NOT LESS THAN 9 INCHES
TOTAL LENGTH ABOUT 18".

NOTE:—It will be observed that the widths given above, being maxima, do not exclude the use of the usual 1½ in. × 8 in. test piece.

OUR WEEKLY BIOGRAPHY.

Photo by Elliott and Fry.

MR. JOHN MATHIESON,

GENERAL MANAGER OF THE MIDLAND RAILWAY.

FEW men have acquired a wider experience of railway affairs or a more comprehensive knowledge of the abstruse details of freight and passenger traffic than Mr. John Mathieson. Born in 1846 at New Cumnock in Ayrshire, he commenced his exceptionally active railway career at the early age of thirteen, when he entered the service of the Glasgow and

South-Western Railway at the station of his native village. His aptitude for business soon met with the approval of his superiors, and after he had spent about eighteen months at New Cumnock station he was transferred to Hurlford, which at that period was the most important mineral centre on the company's line. He spent several years here in the capacity of booking-clerk, and whatever leisure hours were at his disposal he diligently devoted to the study of railway economics.

The authorities were not long in discovering that in young Mathieson they had a servant whose mental equipment fitted him for a higher position, and in 1865 he was promoted to be station-master of Stewarton. He held this post for a few years, when he was singled out for further distinction, and was selected to fill a vacancy in the office of the superintendent of the line. He passed through the various grades, and in 1875, when he was twenty-nine years of age, he was made head of the department.

In 1889 Mr. Mathieson was invited by the late Sir Thomas McIlwraith to go to Queensland as chief of the Commissioners of the State railways of that colony. The offer, which he naturally accepted, was a tempting one, carrying an annual emolument of £3,000.

At the end of his first year's administration in Queensland the capital invested in the railways was £13,606,384. By the end of June 1895 it had increased by new construction to £16,522,293. During the time Mr. Mathieson was responsible for the management the Queensland railways reached a degree of efficiency, combined with economy of maintenance, which they had previously never obtained. The gross earnings rose from £849,868 to £1,025,512, while the working expenses were reduced from £618,798 to £581,973, showing an increase in the net earnings from £231,070 to £443,539. Yet despite all that was accomplished to bring about economical working, Mr. Mathieson retained the high esteem of his staff, from whom he always seems to have a faculty of securing excellent service.

The conspicuous ability displayed by Mr. Mathieson as Commissioner of Queensland met with universal admiration, especially in Victoria, where railway progress was hampered by political control, and the absolute necessity was felt for entrusting the management of the Victorian railways to a strong-minded man, capable of independent action, with a perfect freedom from political bias. The Ministry had keenly observed the unretarded progress of the Queensland system, for which Mr. Mathieson was responsible, they therefore decided to invite him to become Commissioner of the railways of Victoria. In April, 1896, the Minister of Customs opened negotiations with Mr. Mathieson, which resulted in his accepting their offer at an enhanced salary of £3,500 per annum.

At the outset he had to face a deficiency on the annual working of about half a million sterling. In order to effect a substantial reduction drastic reforms were begun immediately he assumed the reins of office; rates and fares were revised, and a thorough reorganisation of every department was carried out. Under his administration the revenue of the railways increased by £623,770. This result was not achieved by a curtailment of the working expenses, for apart from pensions and gratuities, the concessions granted to the staff since 1895-6 aggregated £190,000.

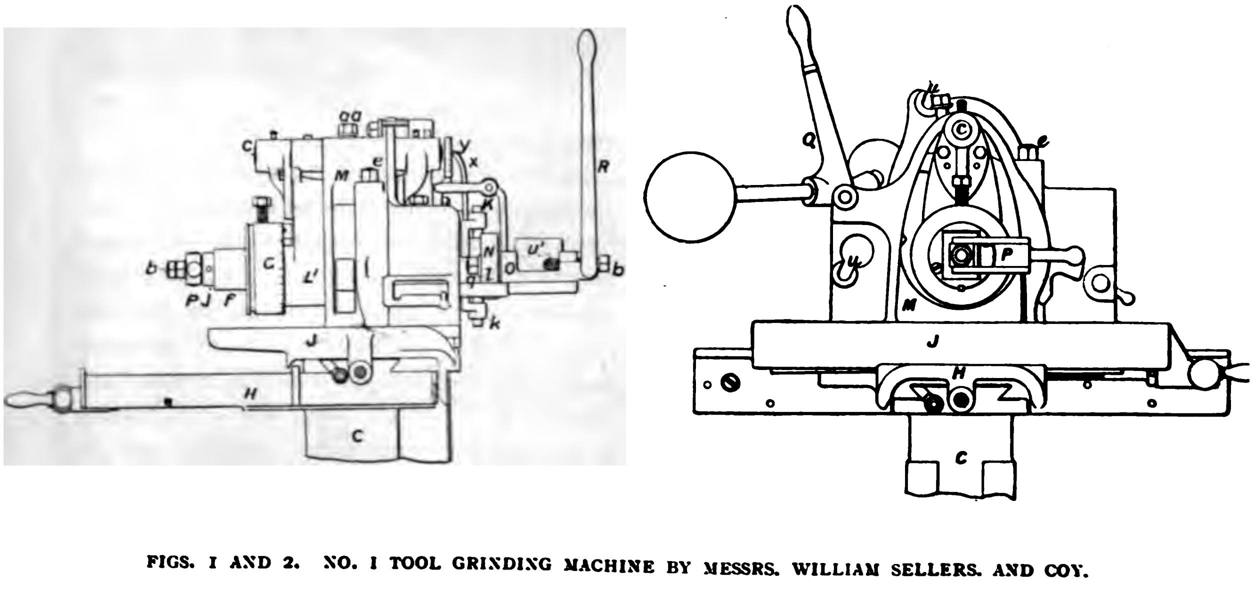
On the resignation of Mr. George H. Turner the Directors of the Midland Railway Company resolved to offer his position to Mr. Mathieson, and in July, 1901, he entered upon his present appointment as general manager of the company. Under his direction many improvements have been introduced and greater facilities afforded to travellers, while the strengthening of the alliance between his company and the one with which he graduated is mainly due to his influence.

"TOOLS FOR ENGINEERS AND WOOD WORKERS."

OF the making of books on this subject there is no end. The great and growing importance of cutting tools in modern practice, and the developments which are constantly taking place in this department of mechanical engineering, have, perhaps, made the multiplication of books inevitable. It is clear, in the first place, that treatises on a subject which is still in a condition of active evolution rapidly become—not obsolete, perhaps—but at all events out of date, while the multitudinous character of the problems to be dealt with is driving authors to specialise rather than make vain attempts to cover the whole field. If Mr. Horner has added measuring instruments to his main subject it is because tools and measuring instruments cannot be separately regarded in shop practice, and this, at least, the critic must concede, that he has treated the subject of instruments of measuring very fully, and has illustrated them to advantage. For the rest, the book is likely to prove useful enough, although the author might very well have sacrificed something of the history of the subject and told us even more than he has of modern practice.

In his opening chapter the author traces the effects of the substitution of the machine-operated tool for the hand-tool producing the interchangeable method of manufacture, a system, as readers are aware, initiated in France and subsequently developed to a high state of perfection in the United States. The introduction of high speed steels in 1900 was a starting-point for new developments, the character of which may be gauged by the amount of space devoted to the subject in the pages of the technical press.

In dealing with tool angles in his introductory remarks, the author takes occasion to point out that the secret of heavy cutting must be credited to lubrication and tool support equally with tool angles, and he is properly insistent upon the importance of discriminate lubrication.



FIGS. 1 AND 2. NO. 1 TOOL GRINDING MACHINE BY MESSRS. WILLIAM SELLERS. AND COY.

The first section of the book is devoted to the "chisel group"—tools used by woodworkers, planes, hand chisels for metal working, and tools for cutting metal, shearing tools and the like. Much of this is familiar matter enough, and is, perhaps, part of the author's plan of being comprehensive within the limits he has marked out. Section II. deals with scraping tools, Mr. Horner being careful to draw a definite distinction between the scrape and the cutting tool. In the third section of the book, an important branch of the subject, that of tools allied to both chisels and scrapes, is treated at some length. Of the vexed questions surrounding saws the author writes fully, with a lofty disregard of the pitfalls which beset the treatment of a subject admitting of so much discussion and difference of opinion. Milling cutters, boring tools, taps and discs, punches and hammers, are discussed in the sequence named. The chapters dealing with these subjects are excellent in their way, but it may be suggested that Mr. Horner might have presupposed some elementary knowledge on the part of the reader of the matters treated.

For the most part, however, it is possible to commend the author's treatment of his subject, and the book is certainly well illustrated, which is always a merit in a work of this kind. From the chapter on tool grinding and sharpening, we reproduce illustrations of the William Sellers No. 1 tool-grinding machine.

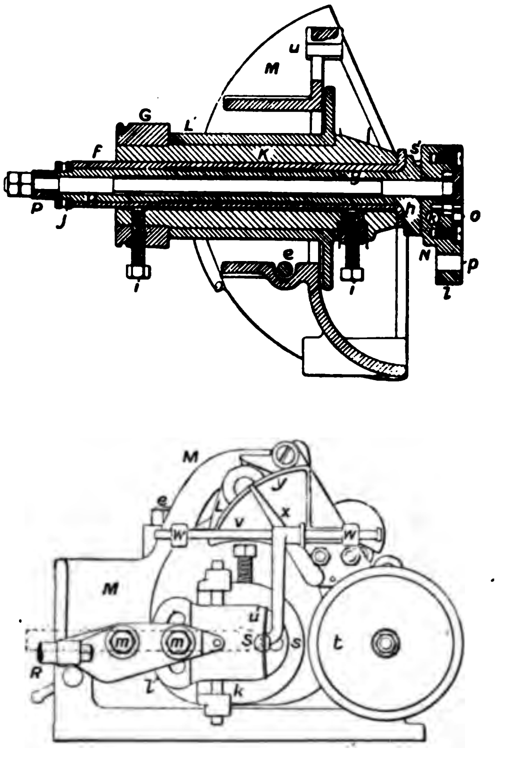
In the Sellers' machines there are two designs embodied, one the larger size in which a wheel is used having two grinding edges of Vee shape, the two meeting at an angle of 90 deg.; the smaller machine having a wheel of ordinary disc shape.

It is a universal machine covering all the tools used in a shop on lathes, planers, shapers, slotters, etc., and taking tools, the shanks of which do not exceed 2½ in. by 2 in. in cross section. The machine is self-contained and there are two chucks, one for grinding straight-faced tools, the other for those having curved faces, and a device for grinding formers.

The case of straight-faced tools, or those the cutting edges of which are produced by the intersection of plane surfaces, is dealt with by the sliding movements, and circular adjustments just enumerated. K (fig. 3) is the chuck used for these, fitting and revolvable with the bearing L. The case of curved-nosed tools involves more elaborate mechanism. Messrs. Sellers have prepared charts giving the most approved angles and clearances for various cutting tools, together with particulars of what formers should be used and position of index finger to be set.

As intimated at the outset measurement problems are discussed at some length. The author rightly insists on the necessity for a uniform international standard of measurement, which, indeed, since the spread of the interchangeable system, has become a practical necessity. Measuring instruments must be adapted to the work, of course; in some instances $\frac{1}{16}$ of an inch approximation is enough; in others $\frac{1}{1000}$ of an inch too little, and in the modern system the degree of accuracy called for in particular cases is predetermined. Modes of measurement are fully discussed, and the gradual change in the practice of modern shops, the result of the invasion of the gauges, is clearly traced. Although as intimated above not a little of Mr. Horner's matter is surperfluous, the work has a good deal of value as a summary of knowledge on the subjects with which it deals, and it will, no doubt, find a ready audience.

The author has dispensed with an appendix, and it will occur to the reader who has tested the references that a little more space might with advantage have been devoted to the index.



FIGS. 3 AND 4. SHOWING MECHANISM EMPLOYED IN THE SELLERS MACHINE FOR GRINDING STRAIGHT-FACED AND CURVED-NOSED TOOLS RESPECTIVELY.

" Tools for Engineers and Woodworkers, including Modern Instruments of Measurement," by Joseph Horner, A.M.I.Mech. E. With numerous illustrations. Crosby, Lockwood and Co.

RECENT DEVELOPMENTS IN ELECTRIC SMELTING.

THE FROGES-HÉROULT PROCESS.

BY ADOLPHE MINET.

(*Continued from page* 511.)

OF all modern industries the electrometallurgy of iron has, perhaps, the greatest future; and the paper by Mr. Harbord, an abstract of which appears in the last issue of PAGE'S WEEKLY, will suffice to show what great interest the subject possesses. His report forms a noteworthy addition to the history of the electrometallurgy of iron. I have been struck by a fact of considerable importance; namely, that one of the proposed methods allows of the complete elimination of sulphur and phosphorus from the materials worked upon. The Froges-Héroult process, to which I allude, has been tested in practice, for by it has been produced 3,000 tons of steel, and the Société de Froges has been placing this steel on the market for the last two years.

This furnace was originally used at Froges for the production of aluminium and its alloys, and later for the manufacture of artificial corundum and calcium carbide. It was afterwards employed for the production of ferro-chrome, ferro-silicon, and ferro-tungsten, at the suggestion of M. Charles Combes.

All these operations have been greatly developed within the last few years at La Praz, at the works of the Société Electrometallurgique Française. The

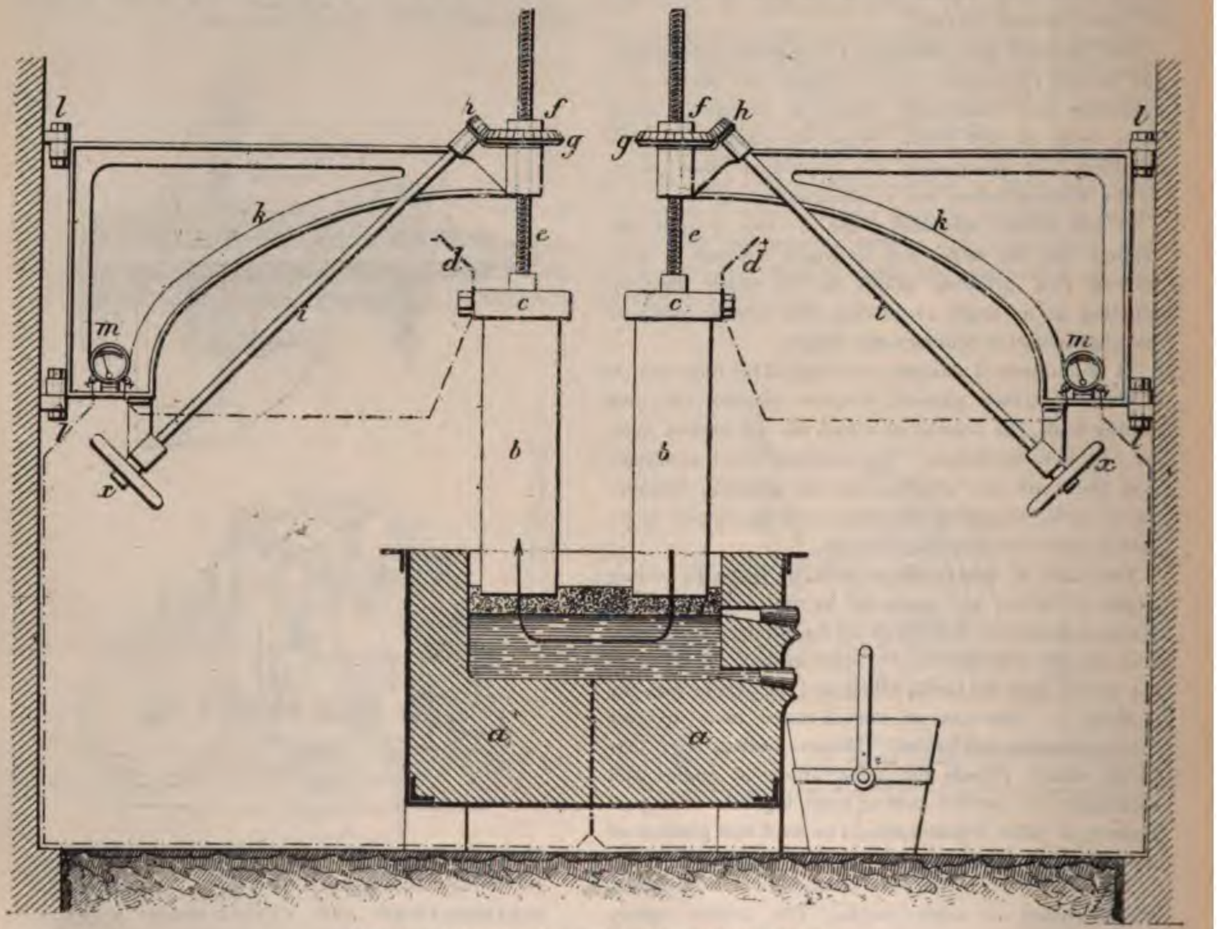


FIG I. FROGES-HEROULT ELECTRIC FURNACE.

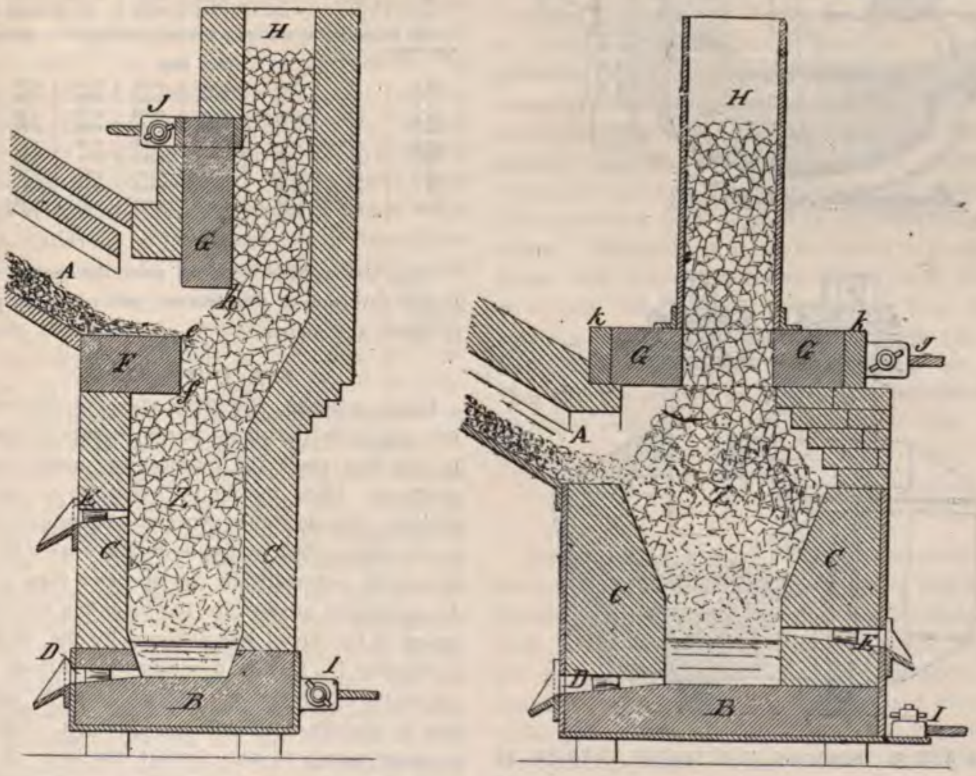
manufacture of ferro-chrome has been so successful that the use of the cupola for its production has been practically abandoned, and the price of material containing 60 per cent. of chromium has fallen from 1,800 francs per ton to 700–800 francs. Observations on the electrometallurgy of chromium naturally led M. Héroult to extend his work to the treatment of iron ores.

Héroult's researches on the electrometallurgy of iron comprise three well-marked stages. Between the first and second stages he made some very interesting experiments on the production of cast-iron. The first stage is marked by a patent taken out in March, 1900. The furnace is constructed in the same way as that used for the production of low-carbon ferro-chrome. It is sufficient to replace the chromite by an iron ore in order to obtain a cast-iron with little carbon. But this method could hardly be used for wrought-iron or steel. At first only pure materials could be treated, the elimination of impurities, like sulphur or phosphorus, not being then practicable. In fact, at the end of the operation there was present either much oxide which had to be recovered, or else metal too highly carburised.

PREPARATION OF CAST-IRON.

Here I will make a slight digression to speak of a series of experiments made by Héroult with the object of making cast-iron in the electric furnace, and to make the yield of his furnace sufficiently good to compete in certain cases with the blast furnace. The process is quite simple. The apparatus is charged in the usual way, putting at the bottom of the crucible a little of the metal, or the ore mixed with coal. But in this case much carbon monoxide is given off, which has no time to react, and the waste gases are much richer in carbon monoxide than those from the blast furnace. Héroult therefore endeavoured to recover the potential heat energy of this gas. This principle has been embodied by Héroult in an arrangement called an "economiser."

The ore, not mixed with the coal, reaches the crucible through a sloping or vertical flue, where it meets with the carbon monoxide passing away. At the commencement of this flue a blast of air is introduced to burn the carbon monoxide. The ore melts and falls into the electric crucible into which the coal is introduced directly through another opening. In figs. 2 and 3 the crucible, or final reaction chamber, is replaced by an

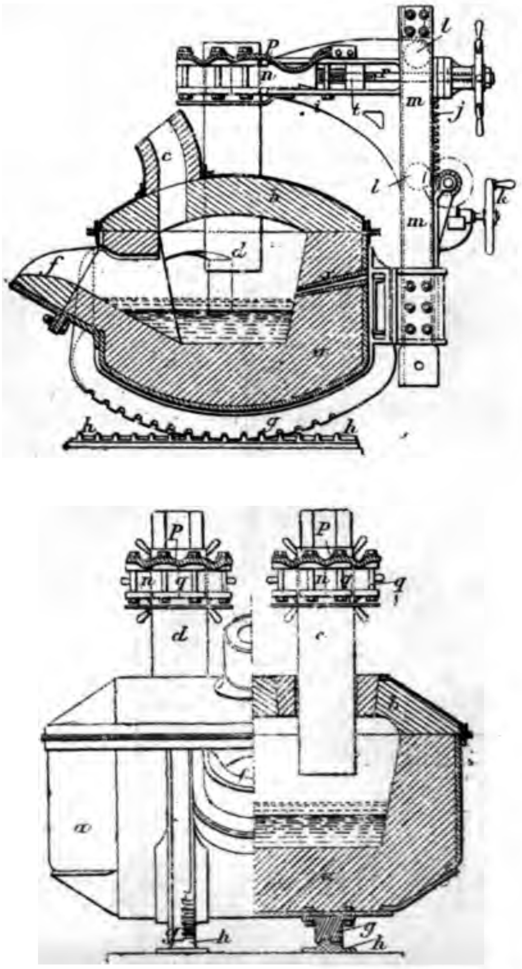


FIGS. 2 AND 3. SLIDING ELECTRODE FURNACE.

arrangement called by the author the sliding-electrode furnace. That is to say, it is the coal itself, which, in its downward progress inside the furnace, forms one of the electrodes, the base of the furnace and the melted metal forming the other.

In the second stage of the investigation the idea of reducing the oxide of iron and refining the metal in the same apparatus is abandoned, and by it the use of previously purified materials is obviated.

The furnace, with two electrodes (see fig. 1) has two tap holes, one for metal, the other for slag, and is charged with solid or melted cast-metal from any source. When the metal is melted, the first slag is withdrawn, and an oxidised slag is formed by the addition of minerals, the decarburisation of the ore is accomplished by the action of this slag on the fused metal. The oxidation being completed, the slag is withdrawn and replaced by an artificial slag repeated as often as necessary for complete purification.



FIGS. 4 AND 5. SHOWING ELECTRODES CARRIED IN SUPPORTS FASTENED TO FURNACE, AND MOVEABLE BY MEANS OF RACKWORK.

One of the advantages of the second modification of the Froges-Héroult process lies in the fact that a very high degree of freedom from sulphur and phosphorus can be obtained in the metal. The purification being accomplished, the required degree of carburisation is obtained by dipping an electrode or a block of carbon into the bath, this being followed by the addition of ferro-silicon, ferro-manganese, or aluminium.

A high degree of purification is obtained.

Analyses of a series of consecutive melts from average materials with commonly occurring impurities, show that with few exceptions the percentages of phosphorus and sulphur remain below 0·01 per cent.

Tests for tensile strength made on Froges electrical steels show satisfactory results.

MECHANICAL PROPERTIES OF ELECTRICALLY SMELTED STEEL.

Resistance.	Lengthening.	Contraction.	S per cent.	P per cent.	Mn per cent.	C per cent.	Si per cent.
			Soft Steel.				
53	26	0·48	0·009	0·024	0·32	0·295	0·05
43	30	0·55	0·006	0·012	0·32	0·14	0·14
49	28	0·49	0·006	0·015	0·28	0·25	0·22
42	31	0·55	0·007	0·016	0·297	0·136	0·07
36	31	0·746	0·016	0·006	0·076	0·089	0·003
38	33·5	0·726	0·018	0·010	0·105	0·107	0·04
39	30	0·706	0·005	0·007	0	0·044	0·073

The last sample but one had a Steinmetz coefficient, $\eta = 0{\cdot}0011$; the last $\eta = 0{\cdot}0012$.

Resistance.	Lengthening.	Contraction.	S per cent.	P per cent.	Mn per cent.	C per cent.	Si per cent.
			Hard Steel.				
68·5	18	0·40	0·015	0·007	0·125	0·70	0·035
82·9	11	0·23	0·011	0·005	0·19	1·38	0·09
73·3	15	0·29	0·007	0·009	0·187	1·49	0·148
86	13	0·29	0·006	0·009	0·08	0·88	0·148
76·2	18·5	0·23	0·017	0·006	0·16	1·30	0·129
69·5	17	0·36	0·003	0·004	0·11	1·19	0·065
49	30	0·55	0·010	0·011	0·51	0·70	0·06
48	28	0·59	0·009	0·026	0·38	0·207	0·06
57	28	0·50	0·021	0·010	0·48	0·285	0·465

From the 15th November, 1900, the metal, with the second variation of the process, was regularly produced in billets and ingots.

THE THIRD STAGE.

Before reaching the third stage of his researches, Héroult made important improvements in his process In the first place the furnace was made capable of oscillation, being moved by hydraulic or electric appliances. The electrodes were carried in supports fastened to the furnace itself by means of rack-work ; these could be moved automatically or by hand (figs. 4 and 5). An important advance in the oxidation and recarburisation of the metal was attained by the invention of "carburite." This is a mechanical carbide of iron, containing much carbon ; it is produced by agglomerating a mixture of iron filings and carbon. The product is dense enough to sink through the layer of slag and reach the metal below, in which it rapidly disintegrates owing to the high temperature of the air. In th way deoxidation and recarburisation can be attained without the use of any foreign material, such as silicon and manganese.

In the 400-h.p. oscillating furnace, a charge consists of 2,500 kilometres of scrap-iron. The melting takes five hours; tapping the first slag a quarter of an hour. The melted or solid artificial slag is then introduced, its melting and tapping takes half an hour. This operation is repeated with a second artificial slag. Each tapping of slag weighs 50–60 kilos. Then carburite is added to deoxidise and produce a steel with less than 0·6 per cent. of carbon. Below this percentage, the carbon content can be very accurately gauged in a trial piece. From the result of this test, the calculated amount of carburite is added. Finally suitable additions are made to reach the desired composition and the metal is tapped. The final addition of carburite and the other materials takes an hour.

Three cycles can be worked in the twenty-four hours as with the Martin furnace.

With the object of still further reducing the expenditure of electrical energy, the oxidation of the melted metal in the crucible is done away with. Starting with cast-iron a basic Bessemer or Martin oxidised metal is obtained. The oxidation is pushed further than is usual in order to completely eliminate the phosphorus. Thus while the ordinary Thomas metal contains 0·03 to 0·05 per cent. of phosphorus, the metal is over-blasted till less than 0·01 per cent. remains. According to the experiments of Héroult the amount of dissolved or combined oxygen in the over-blasted metal reaches 0·7 to 0·8 per cent. Such a metal would be useless in ordinary refining processes, in fact it would require the addition of large quantites of ferro-silicon or ferro-manganese. If, however, this melted metal is taken to the electric furnace, with all traces of phosphatic slag carefully removed, it can be completely deoxidised by means of carburite, and recarburised to the required point in about an hour. Suitable additions of ferro-silicon, manganese or aluminium are then made, and the metal tapped.

Practice has shown that the problem of the thorough deoxidation of steel has been completely solved by the electric furnace. By means of this improvement the output of a furnace becomes considerable, the operation should only take an hour, the energy consumed is greatly reduced, and labour is largely diminished. It thus becomes possible to manufacture second-rate and ordinary steels. Probably the net cost of the steel will always be slightly higher than that of Thomas or Martin, but this increase of cost in many cases is compensated by an improvement in the quality.

To conclude, the Froges-Héroult process is one which in the more or less near future must interest all branches of metallurgy.

Communicated to the Faraday Society.

THE S.S. "HARMONY."

THE steel screw steamer *Harmony* has carried out her official trial trip in Hartlepool Bay. She has been built to the order of Messrs. J. and C. Harrison, Ltd., 66, Mark Lane, London, E.C., and is the third of three sister vessels built by Messrs. Furness, Withy and Co., Ltd., Hartlepool, for the same owners. The vessel is over 335 ft. in length, built on the deep frame principle with a measurement capacity of about 264,126 cubic feet. She is of the single-deck type, with poop bridge and forecastle and takes Lloyd's highest class. The hatches are of large size and are specially arranged for the stowage of bulky cargoes. Wood shifting boards are arranged throughout the holds, cellular double bottom is fitted all fore and aft for water ballast, the after peak being also available as a tank. The most modern appliances and auxiliaries are fitted, including patent steam steering gear at the after end of bridge in house, screw gear aft, winches of powerful design by Messrs. Furness, Withy and Co., Ltd., large multitubular donkey boiler, direct steam patent windlass and stockless anchors. The main engines, supplied and fitted by Messrs. Richardsons, Westgarth and Co., Ltd., Hartlepool, ran satisfactorily throughout the trial, a speed of 12 knots being maintained. The cylinders are 23 in., 40 in., 65 in., by 42 in. stroke with two single ended boilers 15 ft. 6 in. by 10 ft. 6 in. long-built to pass German Law requirements, and working at a pressure of 200 lb. per square inch. The owners were represented by Mr. F. A. Harrison, the builders by Messrs. Aspinall and Parker, and the engineers by Mr. Urquhart. The vessel proceeds to Buenos Aires.

The twin-screw steamer *Clacton*, a fast cargo vessel built to the order of the Great Eastern Railway, by Earle's Shipbuilding and Engineering Company, Ltd., Hull, on her official trial attained a speed of 14⅓ knots per hour, being one-third of a knot in excess of the contract requirements. The long distance trial of 120 miles, provided for by the contract, was completed at the Spurn Lightship. The whole of the long distance run gave 14·6 knots per hour.

OPENINGS FOR TRADE ABROAD.

Germany.

A despatch has been received at the Foreign Office from H.M. Ambassador at Berlin, reporting the exchange of ratifications of the two Treaties between Germany and Russia, which were signed on the 6th December last, concerning two frontier railway lines. These Treaties deal with the construction of a railway between the Warsaw-Kalisch line and the Prussian State Railway at Stalmierzyce, as also with the building of a line between the Herby-Czenstochowa railway and the Prussian State line at Herby. The result will be to facilitate not only local traffic but also internal communications. The length of the various lines to be constructed amount to about 497 miles.

Sweden.

According to the United States Consul at Gothenburg there is an opening for marine motors of the following types: Gasoline (benzine) motors for pleasure launches and boats; kerosene motors for fishing boats, barges, and small tugboats, and small, cheap motors which can be fitted into open rowboats. The Consul remarks that the persons in Gothenburg with means enough to buy first-class motor launches are comparatively few; still there are enough of them to warrant efforts on the part of manufacturers to get an extended market here. The motors should be reliable and in good working order when delivered, and not too expensive; and, he continues, if motors for 14 ft. to 16 ft. rowboats could be made very cheap, and still reliable, I think the demand would be considerable. There are a great many persons of limited means here who like to take a boat trip on the river, or out to the sea, in leisure hours, but even 50 dols. or 75 dols. would be considered by this class far too much for a small motor, when the boat itself could be bought for 13 dols. to 20 dols. The agent selling the motors should be thoroughly familiar with their mechanism—better still if he could have a small workshop where defects could be corrected.

Cape Colony.

The Town Council of Bedford have notified their intention of introducing a bill into Parliament to authorise the Council to acquire an improved water supply. For the purpose of carrying out the works contemplated under this bill it is proposed to raise a loan of £13,000.

The Municipality of Queenstown propose to supplement and increase the water supply of that district by constructing a reservoir and all necessary works connected. A sum of £90,000 will be required for the purpose.

During the ensuing session a bill will be introduced into the Cape Parliament to authorise the Town Council of Port Elizabeth to construct the necessary works for the supply of electrical energy for lighting and power purposes.

Portugal.

A royal commission has been appointed to formulate a scheme for the provision of lighthouses and buoys on the coast of the province of Mozambique.

Servia.

The Servian Government are about to undertake several important public works; these include the construction of light railways, the building of a quay and warehouses in Belgrade, and the improvement of the drainage and water supply of that city. Tenders were invited last year for the construction of railways 0·76 metre gauge; but very few tenders were received, and no adjudication took place. Tenders will be invited in the near future for the supply of rolling stock and metallic bridgework. If all the Government projects are carried out, 1,200 kilometres of railway will be constructed; all the materials will have to be imported.

Argentina.

The Minister of Public Works has been authorised to expend about £11,220 on the following items, to be used in adapting the military port at Buenos Aires to commercial purposes: four hydraulic cranes, one electric accumulator, four automatic weighing machines, thirteen mooring cables and eight anchors, together with the necessary accessories to these articles. All these goods are to be purchased in Europe through the Argentine Legation in London, where plans and specifications are to be forwarded.

ENGINEERING PHOTOGRAPHY.

MANY improvements have, according to the editor of the Process Year-Book,* been made of late in the methods of making prints from engineers' tracings. The cylindrical and semi-cylindrical printing apparatus was the first attempt to secure contact of the prints with the tracings. A sheet of plate-glass was bent to a half-circle and the tracing with the sensitive paper in contact with it laid over the surface, a canvas apron being drawn tight over the back. The glass, which was supported in a frame and swung on trunnions was brought to a vertical position, and an arc lamp suspended in the hollow of the half-circle. Further improvements led to the lamp being made to gradually descend by clockwork so as to evenly expose the whole of the print. It was also soon found that it was quite possible to expose two prints at once by making the apparatus cylindrical with two half-circles of glass joined together. Cylinders up to 9 ft. or 10 ft. in length have been built in this manner, and the apparatus has been brought to the greatest perfection. However, it seems likely now to give place to a still better principle. This consists of the adoption of the rotary principle, which has been applied with so much success to letterpress and lithographic printing, and latterly to bromide photo-printing.

At the Elswick works of Sir W. G. Armstrong, Whitworth and Co., Newcastle-on-Tyne, there is, probably, the largest photographic department in the kingdom in connection with an engineering firm, and an enormous number of prints of all kinds and sizes are turned out annually, not only by the cyano., ferro., and gallic and black line processes, but by silver printing, platino printing, bromide printing, etc., whilst photo-zincography in line and half-tone is being gradually developed. We quote the following additional details from the same source: The department owes its success to the organising ability and inventiveness of Mr. J E. Goold, the chief photographer, but also not less to the liberality of the firm in permitting him to carry out the latest ideas. Mr. Goold has the distinction of having used the largest vacuum printing frame probably in the world, the pressure being applied by exhausting the air from under a rubber sheet which covered the back of the printing paper and tracing, thus utilising the pressure of the atmosphere. This frame, as I remember seeing it, was something like 10 ft. long by about 4 ft. wide. It was exposed by means of two powerful open type arc lamps.

This arrangement, as well as the cylinder printing apparatus, seems likely to be superseded by a novel apparatus which Mr. Goold has recently designed and had made in the Elswick works. It consists essentially of a cylinder formed of glass segments, which is slowly revolved in a horizontal direction, whilst a web of the sensitive paper is fed on to it, and at the same time the tracing to be printed is fed in in contact. Powerful arc lamps are directed on it, and the prints are fully exposed by the time the print has passed them. In this manner cyanotype prints 40 in. wide can be made at the rate of 200 ft. per hour, ferro-prussiate prints at 100 ft. per hour, ferro-gallic at 60 ft. per hour. It would be quite possible to feed in large celluloid film negatives, or even pieces of lace, with the advantage that the whole length of a lace curtain could be printed on to the paper. Thin zinc could also probably be printed in this way, so that the machine opens up great possibilities. It has been working successfully at Elswick for about seventeen months, and does nearly as much work as two of the vertical cylinders. One great feature of the new system is that prints of any length can be done, which is of great value for large continuous drawings.

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* Details of this interesting annual appeared in our last issue.

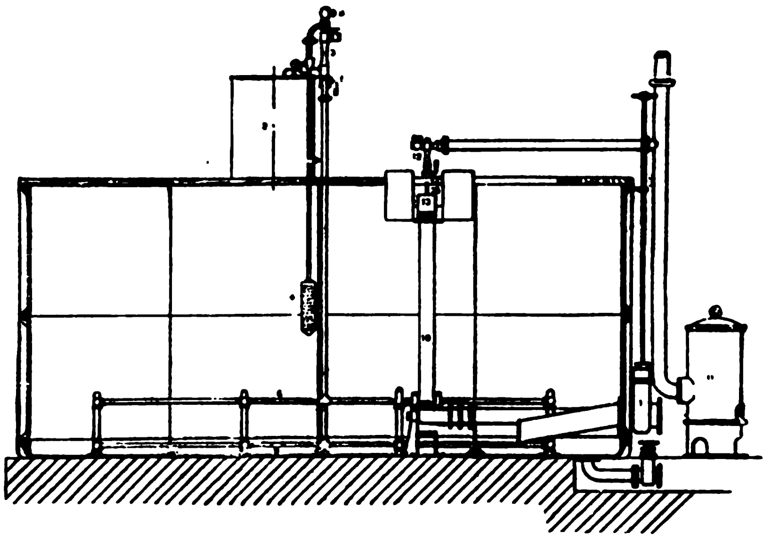
The Archbutt-Deeley Process of Softening and Purifying Water.

THE accompanying diagrams illustrate a plant on the above system suitable for the treatment of from 5,000 to 10,000 gallons per hour. It consists of a cast-iron tank, divided into equal parts by a transverse partition. The two tanks thus formed are fitted up exactly in the same way, the processes of filling, softening, and clarifying being carried on in one, whilst softened and clarified water is being drawn off from the other.

For 3,000 gallons per hour, and less, one softening tank is found to be sufficient if a storage tank is provided. For more than 10,000 gallons per hour, three or more tanks are desirable.

The hard water is admitted to either tank by means of the supply pipe (1) up to the level of a gauge mark on the side of the tank. While the tank is filling, quicklime and carbonate of soda are weighed out and boiled up with water in the small chemical tank (2) by means of live steam. Some waters require also the addition of a little aluminoferric. This is conveniently prepared in the form of a standard solution, of which a measured volume is added to each tank of water immediately after the chemicals have been run in.

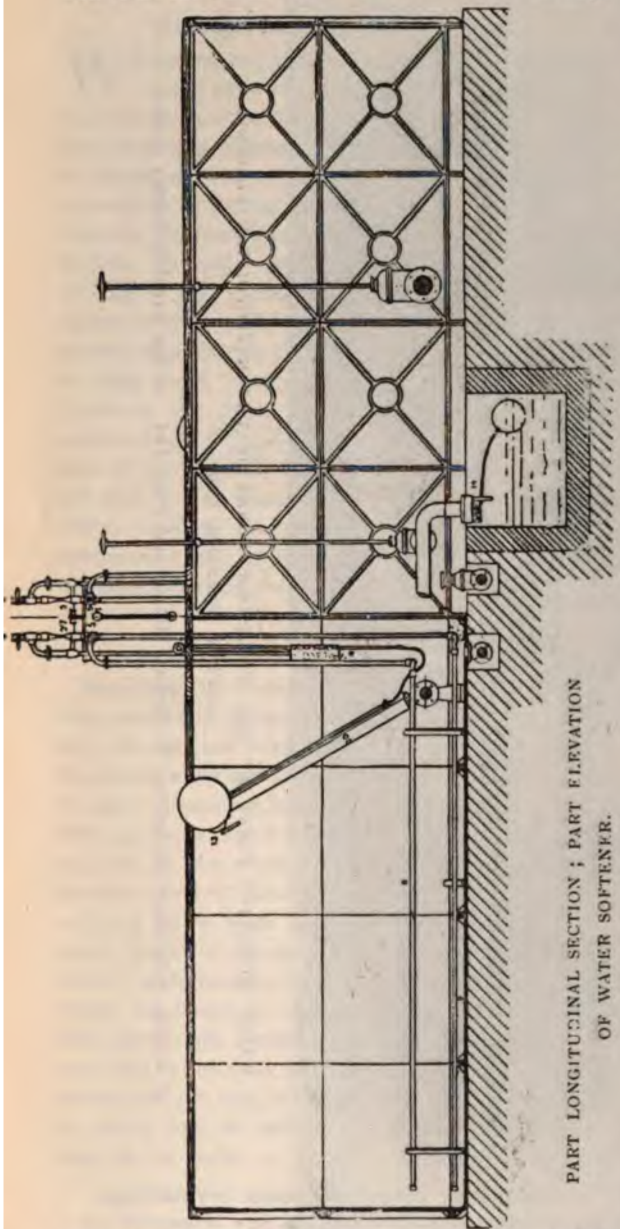
When the tank is full up to the mark, and the inlet valve has been closed, steam is admitted to the blower (3) causing a current of water to circulate up through the rose (4), the three-way tap (5), down the vertical pipe and back into the tank through the perforations in the upper row of horizontal pipes (6). The three-way tap (7) is then opened and the prepared chemical solution is slowly drawn into the circulating current, and thus diffused throughout the body of water in the tank. The air tap (8) is next opened to admit air through the pipe at the top of the blower, and the air is blown for a few minutes into the treating tank through the upper pipes (6); then by reversing the three-way tap (5) the air is forced through the perforations on the underside of the lower row of pipes (9). From these it rises in streams of bubbles, stirring up some of the precipitate or mud from previous operations which lies on the bottom of the tank.



CROSS SECTION OF PLANT.

1, Hard Water Supply; 2, Chemical Tank; 3, Blower for Air and Mixing Chemicals; 4, Perforated Rose; 5, Three-way Tap to Treating Tanks; 6, Upper Perforated Pipes; 7, Three-way Tap to Chemical Tank; 8, Air Tap on Blower; 9, Lower Perforated Pipes; 10, Floating Discharge Pipe; 11, Coke Stove; 12, Blower for Fuel Gas; 13, Discharge Mouth; 14, Ball Tap for Regulating Outlet; 15, Vent Pipe.

After the blower has been in operation for a few minutes (usually ten, but varying with different waters) the steam is turned off, and in about one hour very nearly all the precipitate settles to the bottom of the tank, while the water, even down to a depth of 6 ft. from the surface does not contain on an average more than about one grain per gallon of suspended matter.



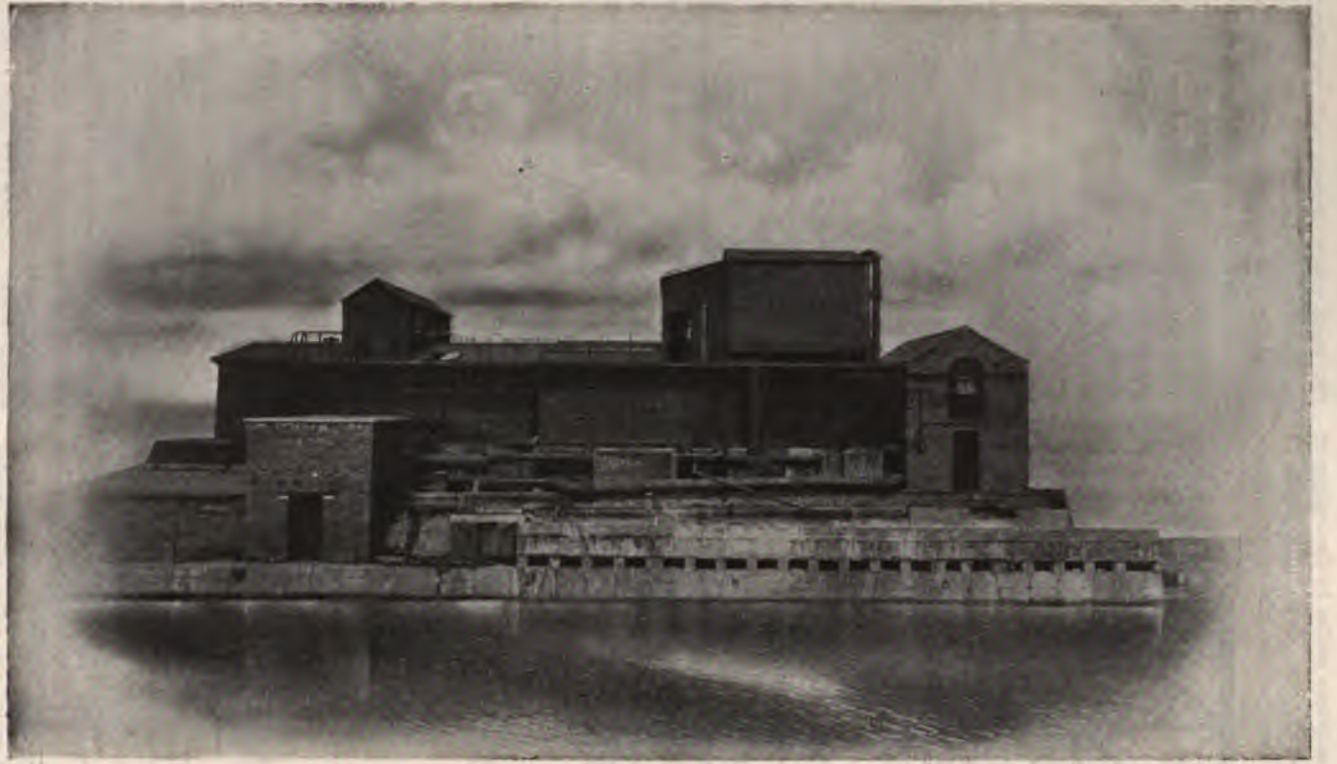
PART LONGITUDINAL SECTION; PART ELEVATION OF WATER SOFTENER.

The operations of carbonating and drawing off are automatically and simultaneously effected by means of the hinged pipe (10) of rectangular section, the mouth of which is kept just below the surface of the water by means of floats. Fuel gas from the coke stove (11) is forced continuously, by means of the small steam blower (12), up the pipe, escaping by the discharge mouth (13), and being caught by the descending current of water (which in flowing down the pipe is repeatedly splashed upwards by baffles fixed at intervals along the bottom) is carried along with the water through the ball tap (14) fixed over the small supply tank, into which the softened and carbonated water falls, whilst the residual nitrogen, etc., of the fuel gas escapes into the air. If the small tank should fill up and cause the ball tap to close, the gas escapes through the vent pipe (15). A gauge mark on the side of the softening tank, about 2 ft. from the bottom, indicates the level below which the water is not drawn off. Shortly before the water reaches this level the further descent of the discharge pipe is stopped by a "rest" fixed on the bottom of the tank.

The quantity of carbonic acid required is only just enough to convert the slight excess of alkali used in softening into bicarbonate, and it is controlled by a very simple test. No injurious effects need be apprehended from the presence of sulphur in the coke, for, assuming the coke to contain 2 per cent, of sulphur, even if all this sulphur were to be oxidised to sulphuric acid, the quantity of sulphuric acid per gallon of water would amount to only 0·055 grain; and as the softened water of three degrees hardness contains fully fifty times as much alkali as is required to neutralise this amount of acid, the sulphur in the coke cannot possibly do any harm whatever.

Experience proves that for boilers, carbonating is not always necessary; and that where it is necessary occasional carbonating is often sufficient to prevent any trouble from deposit in feed pipes. The precipitate is prevented from unduly accumulating in the tank by its partial removal at regular intervals. This is effected in various ways to suit different circumstances. From the nature of the precipitate it is easily dealt with. In small plants, a discharge pipe is provided in one corner of the tank, and by lifting a plug daily a sufficient quantity of mud can be run off. In larger plants the mud is swept out, at longer intervals, through mud doors into a trough which conveys it on to waste ground; or it is raised out of the tank or trough by a steam lifter, and discharged into a cart lined with waste furnace ashes, through which the excess of water readily drains, leaving the nearly dry mud and ashes ready for tipping.

For the above details and illustrations we are indebted to the sole licensees, Messrs. Mather and Platt, Ltd., of Manchester and London.



WATER SOFTENING PLANT AT THE WILLESDEN WORKS OF THE METROPOLITAN ELECTRIC SUPPLY COMPANY, LTD.

A notable installation carried out by Messrs. Mather and Platt, Ltd on the Archbutt-Deeley system.

POWER STATION NOTES.

BY E. K. S.

THERMAL LOSSES IN A BOILER.

WE get so accustomed to considering the steam boiler as an excellent piece of apparatus not to be found fault with, that it is well perhaps to compare the theoretical figures with those actually obtained. A pound of good bituminous coal with the ordinary proportions of hydrocarbons and ash, when combined with its equivalent of oxygen will liberate 14,000 British thermal units; anthracite coal, being practically pure carbon gives a little more, namely, 14,700 British thermal units. Now the heat represented by a British thermal unit would, if expended in doing work, raise one pound weight, 778 ft. high. Therefore, the power in one pound of coal may be expressed as $\frac{14,000 \times 778}{33\,000} = 330$ h.p. As a matter of fact of the original 14,000 thermal units nearly 30 per cent. is lost when the coal is consumed under a boiler. One or two per cent. is accounted for by unconsumed coal in the ashes, 5 per cent. is lost in radiation from the boiler and pipes, and rather under 25 per cent. represents heat escaping up the chimney.

EVAPORATION POWER OF BOILERS.

Regarding the evaporation power of coal it happens that on account of the latent heat of steam, that is to say, the internal work done with the molecules of the steam when assuming the gaseous state, a pound of good bituminous cannot possibly evaporate more than 13 lb. of water if the water is at 62 deg. F., or 15 lb. if the water is at 212 deg. F. Now, in practice, the best boilers only evaporate a little over 10 lb. of water from and at 212 deg. F., and the usual figure is nearer 9 lb. Indeed, many boilers whose performances go unquestioned, would, if tested, be found to come materially short of this. Yet buyers will accept boilers with a sort of blind faith and at the same time make no end of fuss about one or two per cent. in an engine or a dynamo, either of which has an efficiency immensely superior to that of the boiler.

AUTOMATIC COAL WEIGHING MACHINES.

An automatic weigher made by W. and T. Avery, has been supplied to several of the large electric power stations. For example, at Glasgow, 14 Richardson weighers are used in the chutes which supply coal to the mechanical stokers. Each machine weighs 2 cwts. of coal at a time, registering on a counter the exoct number of weighings made. In order to pass through such a machine the coal is of course broken up into pieces about one inch cube, but automatic machines can be made to weigh coal in pieces as large as six inches cube.

MECHANICAL STOKERS AND COAL CONVEYERS ON STEAMSHIPS

It has often occurred to the writer as somewhat strange that the boilers of liners, battleships, and large merchant vessels, are never fitted with mechanical stokers. Surely if mechanical stokers can be made to work so successfully for land boilers there is at least some chance of their succeeding on board ship. The new underfeed stokers appear to be a promising design for steamship conditions, because the coal lies fixedly in a V-shaped trough until it is consumed.

Trimming coal bunkers and bringing it forward to the boilers is another job for which coal conveyors or elevators might be used, and the screw type conveyor would probably be a useful form to adopt Much ingenuity has been expended in developing coal conveyors for central stations, gas works, and even for the coaling of ships at sea, so that it should not be a very difficult job for the experts of such a firm as the C. W. Hunt Company for example, to work out a suitable system of handling coal in the interior of steam ships. It would probably entail redesigning the coal bunker accommodation, but this is after all, merely a matter of re-arrangement of interior bulk-heads.

THE CUTTING ACTION OF HIGH VELOCITY STEAM.

The statement frequently made, that the blades of steam turbines do not show any signs of cutting, is a little difficult to understand by those who know how very much an ordinary stop valve, for example, may be worn by steam passing through it. It is the more inexplicable seeing that in a valve, it is the rush of steam between the valve and its seat just at the point of opening and closing which causes the cutting, or in other words it is the high velocity steam which does the work. As a matter of fact, it is very probable that there is cutting in a steam turbine, but inasmuch as it is spread over such a large surface the amount on each blade is almost immeasurable. The employment also, of superheated steam, no doubt tends to considerably reduce the cutting action.

SHIPBUILDING NOTES.

THE twin-screw steamer *Peshawur*, the latest addition to the extensive fleet of the Peninsular and Oriental Steam Navigation Company, was launched on the 8th inst., by Messrs. Barclay, Curle and Co., Ltd., Whiteinch. The new vessel, which is destined for their eastern and Australian service, is 496 ft. long by 57 ft. 3 in. in breadth by 35 ft. 9 in. in depth moulded. Her deadweight capacity is 10,500 tons, and she is specially designed for the requirements of the Australian trade.

The *Peshawur* is classed to the British Corporation highest standard, and carries a limited number of first-class passengers in commodious staterooms under the bridge. The officers' quarters are also under the bridge, and the crew are berthed in the poop and forecastle. The arrangements for working cargo, which includes ten large steam cranes, four winches, and five derricks (one for lifts up to 30 tons) are such as to ensure the rapid discharge of very large cargoes. Nos. 2 and 3 holds and lower 'tween decks are insulated for the carriage of frozen produce. The refrigerating machinery is placed in a large deckhouse on the upper deck in the forward well, and has been supplied by Messrs. Haslam on the cold air system to enable chambers being kept at a low uniform temperature.

The vessel is lighted throughout with electricity, and the 'tween decks are very efficiently lighted and ventilated in order to comply with the Admiralty requirements for carrying troops. The machinery consists of two sets of powerful triple expansion engines constructed by the builders, and are supplied with steam from two double-ended and two single-ended boilers, with a working pressure of 185 lb.

The vessel and machinery have been specially designed under the superintendence of Mr. Deane for the hull, and Mr. Leslie for machinery, and during the building has been supervised by Mr. H. J. Taylor, Greenock, assisted by Messrs. Lowe and Conner for the hull, and Messrs. Wilson and Smith for the machinery.

The *Peshawur's* keel was laid on 9th August, and the vessel is now launched in seven months from that date. It is expected that delivery will be completed and the vessel handed over in six weeks' time. The total time of construction will therefore be about eight and a half months, or two months earlier than the guaranteed date of delivery.

On Tuesday, the 7th inst., Messrs. Craig, Taylor and Co., launched from their Thornaby Shipbuilding Yard, Thornaby-on-Tees, the steel screw steamer *St. Patrick*, of the following dimensions, viz.: 316 ft. by 44 ft. by 22 ft. 6 in. moulded. She is built of steel to the highest class in Lloyd's, under special survey, and is of the single deck type, with poop, bridge, and topgallant forecastle; water ballast in double bottom fore and aft, and in peak. She is fitted with patent steam windlass, with quick warping ends, by Messrs. Emerson Walker and Thomson Bros., patent steam steering gear, nine large steam winches by Messrs. R. Roger and Co., Ltd., Riley's donkey boiler, Crawford's screw gear aft, and telescopic masts to Manchester Ship Canal requirements, and all the latest improvements. The propelling machinery has been constructed by Messrs. The North-Eastern Marine Engineering Company, Ltd., Sunderland. The ship and engines are being superintended by Mr. Fred Edwards, of London.

The s.s. *Talavera*, built by Messrs. Ropner and Son, of Stockton-on-Tees, for Messrs. Henry Scholefield and Son, of Newcastle-on-Tyne, has made a very satisfactory official trial trip in the Tees bay. Those on board included Mr. Dalgliesh, Captain Temple and Mr. Baxter, the owners' superintendents. Mr. J. R. Garthwaite was in attendance on behalf of the builders.

Messrs. Workman, Clark and Co., Ltd., of Belfast, launched recently from their North Yard a handsomely modelled steel screw steamer, the *City of Karachi*, for the Ellerman "City" Line. The new steamer has a gross tonnage of over 5,000, and is intended for service between Glasgow, Liverpool, London and Calcutta. The *City of Karachi* has been built under the supervision of the British Corporation Registry, qualifying for their highest class, and she fulfils the requirements necessary for a Board of Trade passenger certificate. The five holds, into which the cargo space is divided by steel bulkheads, are capable of receiving locomotives, boilers and heavy machinery, all obstruction having been, as far as possible, avoided by the quarter girder principle of construction. Ample deck machinery has been arranged for rapid loading and discharging of a large and general cargo. Accommodation for a large number of passengers has been arranged. The machinery, which consists of a set of triple-expansion engines embodying the latest improvements, and supplied by steam for three steel multitubular boilers, fitted with forced draught on the Howden system, has been constructed at the builders' engine works.

RATING OF ELECTRICAL MACHINERY.

AT the meeting of the Institution of Electrical Engineers last Thursday Mr. R. Goldschmidt read a paper on "Temperature Curves and the Rating of Electrical Machinery." The following is an abstract:

It is a well-known fact that the energy lost in electrical machines is converted into heat, which causes the temperature of certain parts to rise above that of the surrounding atmosphere, and results in a dissipation of heat by means of radiation or convection. If no dissipation took place at all, the temperature would simply continue to increase in proportion to the time until either the insulation was burnt or the metal was melted. Given the specific heat of the material the calculation of the temperature rise under any given conditions is a very simple matter, and in the case of the two materials, copper and iron, since their specific heat is nearly the same, we may assume an average value.

A CONVENIENT THERMAL UNIT.

As a thermal unit, the kilowatt-hour or watt-second is a more convenient one than the British thermal unit to adopt, and by this means a practical method of measuring the specific heat of copper and iron is arrived at.

In many cases in practice an instrument is used for a few minutes only, and not more than once or twice a day, as, for instance, in such apparatus as starting transformers, the choking coils of single-phase motors, the small motors used for starting synchronous motors, etc. In these cases it is useless to apply the well-known "watts per square inch" rule for calculating the temperature, and it is a mistaken idea in designing these machines, to take into consideration the providing of any cooling surfaces.

Machines which are to work only for a short time with interruptions sufficient to allow them to cool down to the temperature of the atmosphere must be so designed that the flux density and copper density do not exceed a certain amount independent of size and cooling surface.

It can further be stated that with short period apparatus, the flux density is practically only limited by the permeability of the iron, and not by heating, and in determining the section of the wire by the data available there is the certainty of an ample margin of safety, as the loss of heat by dispersion is not taken into account.

Dealing with the temperature curve the author points out that in order to determine the very important practical question, after what length of time a given machine will approach its final temperature within a few per cent., his method of arriving at the answer shows that the final temperature is attained within 5 per cent. at the end of three times the ideal heating time. For a commercial temperature test this time ought to be sufficient, as the temperature would be raised only 1½ deg. more after another hour, assuming the final temperature to be 50 deg. C.

CRANE RATING.

Dealing with crane rating the author points out that usually a crane motor has to stand a one hour's test on full load, independently of what it has to do in actual practice. It is naturally very much simpler to carry out a test of this kind than a test in which the motor has to be alternately switched on and off. It is even an easier test than a continuous rating test. This is the chief reason why the one hour's test is adhered to, and long experience in actual practice has proved that in nearly every case, a motor which stands this test with a moderate temperature rise, is large enough for crane work.

Investigation as to the meaning of the one hour's crane test shows, however, that its simplicity involves a very great inequality, these being a different value for every single machine. It would be desirable, therefore, to find a test, which would give accuracy as well as simplicity. A test with the exact conditions given, for instance, with a period of three minutes' running and seven minutes' stopping is, in practice, somewhat troublesome. Within rather wide limits, the temperature curve can be considered a straight line, and in consequence the temperature is only dependent on the load factor. Therefore, the three minutes' running and the seven minutes' stopping can be replaced by nine minutes' running and 21 minutes' stopping respectively, which would require less attention than the shorter period. The length of the period could be extended a little further still for large machines, and shortened a little for small machines. This "crane test with extended periods" certainly gives more exactness than the one hour's test, and enables the expression "crane rating" to be made more definite, and to allow for different load factors.

MINING NOTES.

WOLFRAM IN QUEENSLAND.

THE high prices and ready sale obtainable for Wolfram have induced hundreds of men to go prospecting for it from one end of Queensland to the other. The most activity prevails in the Walsh and Tinaroo mineral field. Wolfram is of a black or deep brownish-black colour, and has a lustre somewhat resembling black glass, but with a metallic or submetallic tinge. In breaking, it usually cleaves along flat, shining faces very much like antimony, and in this respect is very different from the conchoidal (or shell-like) fracture of broken glass. Where exposed on the surface this cleavage is not always present. The mineral has approximately the weight of metallic copper. On the Hodgkinson Goldfield wolfram and molybdenite frequently occur together in the same lode. The majority of the rich wolfram-producing claims at the Top Camp, Wolfram Camp, lie along a fairly continuous line of lode. The granite rock here, as shown by the exposures in the numerous shafts and open cuts is traversed by numerous contraction-cracks, lying roughly parallel to each other and to the surface of the ground. This occurrence gives the granite the appearance of being stratified, and has no doubt been caused by the shrinking of the granite as it cooled and solidified from a molten mass. In many of the claims the quartz of the lodes, on being followed down by vertical shafts for a few feet, has "cut out" on a floor of granite along which it spread in a horizontal direction. These horizontal veins, on being excavated by mining after the manner in which a horizontal coal-seam is mined, are seen to lie parallel to the contraction cracks of the granite, along one of which they have apparently been formed. These horizontal veins do not generally extend to any great distance laterally from the line of lode, being confined, as a rule, to within a short distance on either side of it. They vary greatly in thickness, and, as the granite is broken across by numerous vertically-disposed cross-joints they are very irregular in their course. The vertically-disposed cross-joints also frequently contain seams of quartz and mineral, as if they were formed previously to the disposition of the ore. The thickness of these seams of ore is never much more than 10 in. or 12 in. Some of the vertical standing main lodes, however, open out into large bodies 3 ft. and 4 ft. in thickness, but do not generally continue at that thickness for more than a few yards.

ELECTRICITY IN MINES.

WITH reference to the list of new special rules issued by the Home Office regarding the installation and use of electricity in mines, the following letter has been addressed to each mine owner in the United Kingdom:—

Home Office,
Whitehall.

Sir,—I am directed by the Secretary of State to transmit to you herewith a notice of proposal, under Section 54 of the Coal Mines Regulation Act, 1887, of new special rules regulating the installation and use of electricity in mines. The rules, which are based on the recommendations contained in the report of the Departmental Committee on the Use of Electricity in Mines, have been agreed upon in their present form between the Secretary of State and the Mining Association of Great Britain. It will be observed that a number of the detailed rules suggested by the Committee as to the construction, etc., of electrical apparatus have been omitted. It is proposed to embody these recommendations of the Committee in a Memorandum which will call attention generally to the points to be attended to in the erection of plant. This will be issued to colliery owners subsequently. The rules as to shot-firing recommended by the Committee have also been omitted (with the exception of two) as being out of place in the present code. The question of the adoption of the Committee's recommendations on this point will be considered separately. The Secretary of State is proposing these rules to all mines under the Coal Mines Act (with the exception of a few very small workings), whether using electricity at present or not, or whether using it for all the purposes dealt with in the rules or only for some of them. He considers it necessary to do this in order that the safety requirements laid down may come into force automatically, and without delay, immediately the use of electricity is introduced into a mine for all or any of the purposes dealt with. Where electricity is not at present used for any purpose other than shot-firing or is only used for minor purposes such as signalling, the rules will either not apply at all or only such as refer to that special purpose. If you do not object in writing to the rules within 20 days after the receipt of the rules by you, the rules will become established at your mine.—I am, etc.,

HENRY CUNYNGHAME.

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts.

CONTRACTS OPEN.

Last Day.

Birmingham.—Supply and delivery of certain special tramway castings and works in manganese steel to British standard No. 4 section of rail, with all necessary fishplates, anchor pieces, and connecting rails of No. 4 and No. 4c sections, for the Public Works Committee. City Surveyor's Office ... ... March 20

Derby.—Supply and delivery of materials and construction of works in connection with the permanent way and electrical equipment of a portion of their authorised electric tramways, and the supply and delivery of cars. Plans, etc., for permanent-way construction from the borough surveyor and engineer (Mr. John Ward) and for the cars from the borough electrical engineer (Mr. T. P. Wilmshurst) ... March 21

Peterborough.—Supply and erection of the following plant, for the Corporation: (Section No. 1) Lancashire boilers, superheaters and economiser; (Section No. 2) triple expansion vertical engines, pumps, electric lighting set, travelling crane, workshop fittings, and tools; (Section No. 3) piping, injector, feed pump, tank, and feed-water softener. Mr. John C. Gill, Waterworks Engineer's Office, Peterborough ... ... March 23

Manchester. — Construction of a steel trough bridge, with concrete abutment, for the Manchester Ship Canal Company. Particulars from Mr. W. H. Hunter, chief engineer, 41, Spring Gardens, Manchester. March 23

Aston Manor.—Reconstruction of existing tramways in their district and the construction of other works in connection therewith, for the Corporation. Tramway contractors desiring to submit tenders for the works are requested to send applications to the consulting engineer, Mr. Robert Green, A.M.I.C.E., 37, Waterloo Street, Birmingham ... ... March 24

Grindleford and Rowsley.—Construction of the Grindleford to Rowsley section of the Derwent aqueduct, in the county of Derby, for the Derwent Valley Water Board. Mr. Edward Sandeman, Engineer, Bamford, Sheffield .. .. March 27

Hornsey. — Supply of cables, junction boxes, fuse boxes and meters. Mr. Norman Staniland, Electricity Works, Tottenham Lane, London, N. ... ... March 27

Marylebone.—Carrying out of certain installation work and alterations to existing consumers' installations in the Marylebone district for the Borough Council. Specification, etc., from the electricity offices, 11, Manchester Street, London, W. March 27

Last Day.

Keighley.—One Lancashire boiler, and one 300-k.w. direct-current steam dynamo, high-speed enclosed engine, for the Electricity Committee. Particulars from Mr. J. M. Smith, borough electricul engineer, Electricity Works, Keighley. Deposit, £1 1s. ... ... March 27

Great Yarmouth.—Supply and delivery of (Section 3) surface condenser, with steam-driven air and circulating pumps, for the Corporation. Messrs. Preece and Cardew, 8, Queen Anne's-gate, Westminster, S.W. March 29

Bolton.—Supply and erection of cooling tower and condensing apparatus in connection with power station, for the Electricity Committee. Mr. Arthur A. Day, borough electrical engineer, Spa Road, Bolton ... ... March 30

Manchester.—Supply and erection of a Livesey washer and a rotary washer scrubber, for the Gas Committee. Specification from Mr. C. Nickson, superintendent, Gas Department, Town Hall ... March 30

Shanghai.—The Shanghai Municipal Council invite tenders for the construction and operation of about 24 miles of electric tramways on the trolley system in the streets of the Settlement of Shanghai; alternative proposals are desired for the single-trolley and double-trolley lines. Council's agents, Messrs. John Pook and Co., 63, Leadenhall Street, London, E.C., and Messrs. Fearon Daniel and Co., 90, Wall Street, New York. ... . March 31

Newport (Mon.).—Construction of main outfall and branch sewers for the Western Valleys Sewerage Board. Particulars at offices of Mr. Baldwin-Latham, Parliament Mansions, Victoria Street, S.W.; Mr. Geo. Chatterton, 6, The Sanctuary, Westminster, S.W.; or Mr. T. S. Edwards, Clerk to the Board, Newport (Mon.) .. April 1

Rishworth (Yorks.)—Construction of a concrete service tank (56,000 gallons), on Rishworth Moor, including wood and slate roof, for the Rishworth Urban District Council Waterworks. Messrs. Richard Horsfall and Son, surveyors and architects, 22a, Commercial Street, Halifax April 1

Birmingham.—Supply, delivery, and erection of 200 electric tramway cars for the Tramways Committee. Mr. Alfred Baker, general manager, 254A, Corporation Street, Birmingham ... ... April 4

Glasgow.—Electric power generating and lighting plant for Clydebank Dock, for the Trustees of the Clyde Navigation. Mr. T. R. Mackenzie, general manager and secretary, 16, Robertson Street, Glasgow, or from Mr. Geo. H. Baxter, mechanical engineer ... ... April 10

COMING CONTRACTS.

Darlington.—Extensions of the electricity works, to cost from £2,000 to £3,000, are anticipated.

Nottingham.—The Corporation have approved the erection of a refuse destructor for Basford.

Burslem.—The Town Council have completed the purchase of land for the refuse destructor and electric lighting station at £4,340.

Faversham.—The Council are recommended to put down additional generating plant at an estimated cost of £4,800.

Finchley.—The Council are applying for sanction to a further loan of £23,500 for electricity extensions.

Gosport.—At the half-yearly meeting of the Gosport Waterworks Company it was mentioned, during the course of the meeting, that the new scheme for the supply of water was estimated to require a capital of £50,000.

Ayr.—At the last Council meeting a report from engineers on the proposed new reservoir for Kilbirnie and Glengarnock was approved, and it was resolved to ask for a loan for £21,500 to defray the cost of the works.

CONTRACTS CLOSED.

London.—The Brush Electrical Engineering Company, Ltd., have received orders for eight double-deck cars with radial trucks and Brush motor equipments, and overhead equipment for tramways for the Leamington and Warwick tramways, and eight 500 k.w. 3-phase transformers for the County of Durham Electrical Power Distribution Company.

London.—J. Williams and Sons, Cardiff, have secured an order for 1,500 tons of castings for one of the London tube railways.

London.—The City and South London Railway Company have let a contract to Walter Scott and Middleton for the construction of the extension of their line from the Angel, Islington, to Euston, about 1¼ miles.

Stockport.—R. W. Blackwell and Co. are supplying the overhead equipment for the electrification of the Hazel Grove route of the Stockport tramways.

Lochgelly.—The Wilson and Clyde Coal Company, Ltd., have placed an order with Andrew Barclay, Sons and Co., Ltd., for one of their Oddie-Barclay patent mine pumps, which is to raise 75 gals. per minute, 1,000 ft. head, at 160 revolutions per minute.

Middlesbrough.—The North Eastern Steel Company, Ltd., have placed an order with E. F. Jarvis for one of his Patent Open Type "British" Water-Cooling Towers, for cooling the Tuyere Water for their blast furnaces.

Chelsea.—The Chelsea Electricity Supply Company have accepted the tender of J. Greenwood, Ltd., for the erection of a new generating station at Manor Street, Chelsea, at £11,865.

King's Lynn.—The tender of the General Electric Company has been accepted by the King's Lynn Corporation for a steam dynamo (Belliss engine) with condenser and piping.

Brighton.—The Corporation last week accepted the tender of Siemens Brothers and Co. for the supply and laying of low-tension cables at £2,350.

Burslem.—The Corporation have accepted the tenders of Grant and Son for the erection of electricity works and refuse destructor buildings at £3,745 and destructor chimney at £850, and that of Crompton and Co. for switchboard at £598 and for arc lamps at £443.

APPOINTMENTS VACANT.

	Last Day.
Bermondsey.—Electrical engineer to the Council, at a salary of £425. The duties will include the management and running of the electricity and dust destructor works. Town Clerk, Town Hall, Bermondsey, S.E.	March 22
Bristol.—Junior assistant for physics is required at Merchant Venturers' Technical College, Bristol. Salary £130 to £160. Particulars obtainable from Registrar ...	March 23
London County Council.—Two divisional inspectors (at £600 per annum, rising by annual increments of £25 to £800), one possessing special qualifications in mathematics and science and the second in technology, including electrical and mechanical engineering; also an inspector in wood and metal work at £400, rising to £500...	April 1
Middlesbrough.—The Education Committee require a teacher of engineering in the high school. Salary £200.... ...	—

APPOINTMENTS FILLED.

Transvaal.—Mr. L. S. Smart, the manager of the locomotive works at Brighton of the London, Brighton, and South Coast Railway Company, has been selected to fill the important position of chief locomotive superintendent of the Central South African Railways (Transvaal and Orange River Colonies).

Newcastle-on-Tyne.—Mr. Ernest Hatton, general manager of the Salford tramways, has been appointed tramway manager at Newcastle. The salary is £700 per annum.

Manchester.—The Town Council appointed Mr. Hancock, principal clerk in the traffic department, at £180 per annum, as parcels superintendent at a yearly salary of £250, and Mr. J. Eades, jun., carworks manager, at £250, as rolling stock superintendent at £350 a year.

Lisbon.—Mr. N. A. Bell, accountant in the tramways department of the Glasgow Corporation, has been appointed chief tramway accountant in Lisbon at a salary of £400 per annum.

Glasgow. — Mr. Lackie, chief assistant, has been appointed chief engineer of the electricity department in succession to Mr. Chamen. Mr. Lackie's salary is at present £500, and it was raised to £800, rising to £1,000. The Committee decided to ask the Council to sanction the appointment of Mr. Page, as chief assistant at a salary of £500.

Wigan.—Mr. Theodore Partington, engineer-in-chief of the Pemberton station, has resigned his position, and the Electric and Tramways Committee, has decided to put the Pemberton station under the sole control of Mr. Slevin, the borough electric engineer.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

The following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares business is being currently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our Share List will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from possible inaccuracies.

STOCK EXCHANGE SETTLING DAYS.—Settling days on the Stock Exchange are as follows:—

Consols: April 5th. General Settlements: March 30th, April 13th, 28th. Bank Rate, March 9th, 1905, 2½ per cent.

I.—ENGINEERING, IRON, AND STEEL COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
11,370	5	5%	Alldays & Onions Pneumatic Engineering, Ltd.	3	2¾— 3
10,000	5	3/-	Do. Cum. Pref. 6 per cent. ..	5	4½— 5
3,210,000	1	2/6	Armstrong (Sir W. G.), Whitworth and Co., Ltd.	1	3 5/16 — 3 7/16
76,970	5	2/-	Do. 4% Cum. Pref.. ..	5	5⅜— 5⅝
1,500,000	100	4%	Do. 4% 1st Mort. Dbs. Rd.	100	104 —106
£100,000	100	4½%	Aveling and Porter, Ltd., 4½% Reg. Mt. Debs. Red.	100	96 — 99
530,000	1	1/7½	Babcock and Wilcox, Ltd., Ord. ..	1	4⅛— 4⅜
100,000	1	7⅕d.	Do. ,, 6% Cum. Pref.	1	1½— 1⅝
20,000	5	3/-	Baker (Joseph) and Sons, Ltd., 6% Cum. Pref.	5	5 — 5½
250,000	1	6⅗d.	Baldwins, Ltd., 5½% Cum. Pref. ..	1	1 — 1⅛
£250,000	Stk	4½%	Do. 1st Mt. 4½% Deb. Stk. Red.	100	101 —103
150,000	4½	2/8⅗	Barrow Hæmatite Steel Co., Ld., O.	4½	1⅜ — 1⅝
50,000	4½	6/-	Do. do. Cum 2nd. Pref.	4½	4⅜— 4⅝
33,334	5	2/6	Bayliss, Jones and Bayliss, Ltd., 5% Cum. Pref. Shares	5	4¾— 5¼
£500,000	100	—	Beardmore (Wm.) & Co., Ltd., 4½% 1st Mt. Debs., Red., Scrip 50% pd	—	102 —104
50,000	10	6/-	Bell Brothers, Ltd., 6% Cum. Pref.	10	11¾— 12¼
£366,600	Stk	4%	Do 4% Deb. Stock, Red.	100	99 —101
200,000	1	1/-	Beyer, Peacock and Co., Ltd., Ord.	1	⅝ —11/16
300,000	1	6⅗d.	Do. 5½% Cum Pref.	1	27/32 — 29/32
£300,000	Stk	4¼%	Do. 4¼% Red. Deb. Stock	100	96 — 99
1,629,760	1	6d.	Bolckow, Vaughan and Co., Ltd., O. Nos. 1-1,629,760	1	1 —1 1/16*
1,860,900	1	3⅗d.	Do. Nos. 1,639,101-3,500,000	12/-	17/32— 19/32*
1,160,000	1	4⅘d.	Brown (John) and Co., Lim., Ord., Nos. 1-1,160,000	15/-	1 3/16— 1 5/16
590,000	1	6d.	Do. Ord., Nos. 1,160.001-1,750,000	1	1 25/32— 1 27/32
74,000	10	5/-	Do. 5 % Cum. Pref.	10	11¼— 11¾
154,500	5	2/6	Cammell, Laird & Co., Ltd., Ord. ..	5	8¼— 8¾
232,500	5	2/6	Do. 5% Cum. Pref. ..	5	5 5/16— 5 7/16
450,000	1	1/6	Clayton & Shuttleworth, Ltd., Ord.	1	1 — 1 1/16
70,000	5	2/6	Do. 5% Cum. Pref.	5	5⅜— 5⅝
£250,000	Stk	4%	Do 4% 1st Mort. Db. Stk. Red	100	100 —102
100,000	10	7/6	Consett Iron Co., Ltd., Ord.. ..	7½	32— 33
57 031	10	10/-	Crossley, Bros., Ld , Ord. 40340/97370	10	16½—16¾
40,339	10	5%	Do 5% Cum. Pref.	10	11⅞—12⅛
75,000	1	2/6	Delta Metal, Ltd. Shares	1	2⅛— 2¼
1,259,594	1	3⅗d.	Dorman, Long & Co., Ltd.	1	⅝— 11/16
£400,000	Stk	4%	Do. 4% 1st Mort. Perp. Deb. Stk.	100	91 — 94
200,000	5	3/-	Dunderland Iron Ore Co., Ltd., 6% Cum. Pref. and Participating..	5	3⅜— 3⅝
250,000	1	9⅗d.	Dunlop (James) & Co., Ltd., Ord...	1	⅝— ¾
300,000	1	7⅕d.	Do. 6% Cum. Pref. ..	1	29/32 - 31/32
4,721	13	12/-	Ebbw Vale Steel, Iron & Coal Co., Ltd.	13	9 — 10
69,754	13	12/-	Do. do. do.	10	7⅜— 7⅝
20,250	10	8/-	Elliott's Metal, Ltd.	8	4¾— 5¼
5,000	10	5%	Do. Cum. Pref. 5%	10	8¾— 9¼
186,748	Stk	4%	Do. Deb. 4%	100	94½ — 96½
25,000	10	6/-	Fairfield Shipbuilding & Engng. Co., Ltd., 6% Cum. Pref. ..	10	10¾— 11¼
£250,000	Stk	4½%	Do. 4½% Mort. Deb. Stk .Red.	100	100 —103
9,000	10	10%	Fleming & Ferguson, Ltd. Ord. Nos. 1/9000..	10	12½—12¾
6,000	10	5%	Do. 5% Cum. Pref. Nos. 9001/15000	10	9½—10
126,000	3	3/-	Fraser & Chalmers, Ltd., Ord. ..	3	4⅝— 4⅞
21,000	3	1/6	Do. 7½% Cum. Pref.	3	5¾— 6¼
10,000	10	5%	Galloways, Ltd., 5% Cum. Pref. 18001/28000	10	6 — 7
£150,000	Stk	4%	Do 4% 1st Mort. Deb Red..	100	90½—91½
16,800	10	—	Greenwood & Batley, Ltd., Ord. ..	10	4 — 4¼
9,600	10	7%	Do. 7% Cum. Pref	10	10¼— 10¾
965,000	1	1/-	Guest, Keen & Nettlefolds, Ltd. Ord.	1	2 5/16—2 7/16*
344,000	5	2/6	Do. 5% Cum. Pref.	5	6 — 6¼*
£1,850,500	Stk	4%	Do. 4% Irred. Mort. Deb. Stk	100	107 —109
13,000	5	2/6	Gwynnes, Ltd., 5% Cum. Pref. ..	5	2 — 3
250,000	1	1/-	Hadfield's Steel F'dry Co., Ld., Ord.	1	3 5/16— 3 7/16
20,000	10	4/6	Do. 4½% Cum. Pref.	10	10¾ — 11¼
30,000	5	3/-	Hall (J. & E.), Ltd. 6% Cum. Pref...	5	5 — 5½
408,505	1	1/6	Harvey United Steel Co., Ltd. ..	1	1 5/16— 1 7/16
47,500	10	7½%	Hawthorn, Leslie & Co., Ltd. Ord.	10	10¾— 11
28,001	5	7/-	Head, Wrightson & Co., Ltd. ..	5	4¾— 5¼
85,000	1	7⅕d.	Hill (Richard) & Co. (1899) Ld., Ord.	1	⅝— ¾
18,000	5	3/-	Do. 6% Cum. Pref.	5	4⅝— 4⅞
30,000	10	6/-	Hornsby (Richard) & Sons, Ld., Ord.	8	5½— 6

ENGINEERING, IRON, AND STEEL COMPANIES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices
750,000	1	6d.	Howard & Bullough, Ltd., Ord. ..	1	1⅝ — 1¾
25,000	10	6/-	Do. 6% Pref. (Non-Cum.) ..	10	13 — 13½
£250,000	Stk	4%	Do. 4% Deb. Stk., Red. after 1905	100	98 —101
37,500	10	20	Kynoch, Ltd.	10	18¾— 19¼
49,537	10	5%	Do. Cum. Pref. 5%	10	10¾— 11¼
300,000	1	4⅘d	Lambert Bros., Ltd., Ord.	1	⅝— ⅞
50,000	5	2/9	Do. 5½% Cum. Pref.	5	4 — 4½
40,000	3	2/1⅕	Leeds Forge Co , 7% Cum. Pref. ..	3	3¾— 4¼
200,000	1	7⅕d	Lysaght (John), Ltd., 6% Cum. Pf.	1	1 5/16— 1 7/16
£300,000	Stk	4½%	Do 4½% 1st Mt Deb. Stk., Red.	100	108 —110
40,000	10	5/-	Mather & Platt, Ld., 5% Cum. Pref	10	11 —11½*
210,000	1	8⅖d.	Measures Bros., Ltd., Ord.	1	⅝— ¾*
75,000	1	6⅗d.	Do. 5½% Cum. Pref.	1	⅞— 1
£75,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk.,Red.	100	94 — 97
21,943	5	2/6	Muntz Metal, Ltd.	5	5½— 5¾
14,248	5	5%	Do. Pref. 5%	5	5⅛— 5⅜
5,000	62½	47/6	Nantyglo and Blaina Iron Works, Ltd., 8% Cum. Pref.	62½	76 — 80
73,000	10	5/-	N. Brit. Loco. Co., Ltd., 5% Cm. Pf.	10	12⅛— 12⅜
80,000	5	—	North-Eastern Steel Co., Ltd., Ord.	5	—
£250,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk.,Red.	100	90 — 93
122,000	5	2/-	Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B"	5	4 — 4¼
50,000	5	3/-	Do. 6% Cum. Pref. "A" ..	5	5¾— 6¼
70,000	10	6/-	Pease & Partners, Ltd., Ord. ..	10	10½— 11
£400,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	97 —100
20,000	5	3/-	Peebles (Bruce) & Co., Ld., 6% Cm.P.	5	4¾— 5
65,000	1	—	Pooley (Henry) & Son., Ltd., Ord ..	1	6/6— 7/-
13,000	5	—	Do. 5½% Cum. Pref.	5	4 — 4¼
230,000	1	—	Projectile Co. (1902), Ltd., Ord. ..	1	½— ⅝
126,938	5	2/-	Rhymney Iron Co., Ltd.	5	1⅞— 2
73,062	5	2/-	Do. New	5	1½— 1¾
£330,000	—	5%	Do. 5% Mort. Deb., Red. ..	100	100 —102
350,000	1	7⅕d.	Richardsons, Westgarth & Co., Ltd., 6% Cum. Pf. ..	1	⅞— 15/16
£350,000	Stk	4½%	Do. 4½% Perp. Deb. Stock ..	100	94 — 96
35,000	10	12/-	Ruston, Proctor & Co., Ltd... ..	10	9½— 10
275.000	1	6d.	Scott (Walter), Ltd., Ord.	1	13/16— 15/16
300,000	1	7⅕d.	Do. 6% Cum. Pref. ..	1	1— 1⅛*
£300,000	Stk	4%	Do. 4% Perp. Deb. Stk	100	94 — 96
£115,300	100	5%	Shelton Iron, Steel and Coal Co., Ld. 1st Charge 5% Debs.. Red ..	100	92 — 95
£97,900	100	6%	Do. 6% 2nd Mort. Debs., Red.	100	91 — 95
250,000	1	1/-	South Durham Steel & Iron, Ltd. Or.	1	⅝— 11/16
300,000	1	7⅕d.	Do. 6% Cum. Pref...	1	15/16 — 1
£300,000	Stk	4½%	Do. 4½% Per. Deb. Stock	100	90 — 93
49,560	10	2½%	Steel Co. of Scotland Ord. 1/49560..	9	5 — 5½
£125,240	Stk	5%	Do. 5% Trust Mort. Deb. ..	100	106½—107½
25,000	10	—	Stephenson (Robert) & Co., Ltd., Or.	10	2¼— 2¾
25,000	10	5/6	Do. 5½% Cum. Pref. ..	10	4¼— 4¾
£250,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	79— 82
85,000	10	9/-	Stewarts & Lloyds, Ltd., Ord. ..	10	17¼— 17¾
55,000	10	6/-	Do. 6% Cum. Pref.	10	14¼— 14¾
634,732	1	4.69d.	Swan, Hunter & Wigham-Richardson, Lim. Ord.	1	¾— ⅞
538,845	1	6d.	Do. 5% Cum. Pref. .. .	1	15/16— 1 1/16
£240,000	Stk	4¼%	Do. 4¼% 1st Mort. Deb. Stk. Red	100	98 — 101
300,000	1	6d.	Thames Iron Works, Shipbuilding & Engineering Co., Ltd., 5% Cum. Pf.	1	½— 9/16
£200,000	100	4%	Do. 4% Irredeem. 1st Mort. Deb.	100	67 — 71
£160,000	1	7⅕d.	Thornycroft (John I.) & Co., Ltd. 6% Cum. Pref.	1	15/16— 1 1/16
10,000	10	5/-	Tylor (J.) & Sons, Ltd. 5% Cum. Pf.	10	9½— 10
$508495200	$100	$½	United States Steel Corp. Com. Stk	$100	37¾— 38
$360314100	$100	$1¾	Do. 7% Cum. Pref. Stock	$100	99⅝— 99⅞
$162268000	$1000	5%	Do. 10-60yr. 5% Skg. Fd. G. Bds.	$1000	98 —100
3,350,000	1	1/-	Vickers, Sons & Maxim, Ltd. Ord..	1	2 9/16— 2 11/16
750,000	1	6d.	Do. 5% Non-Cum. Pref. ..	1	1 3/16 — 1 5/16
£750,000	Stk	5%	Do. 5% Non-Cum. Pref. Stock.	100	116 —119
£1,250,000	Stk	4%	Do. 4% 1st. Mort. Deb. Stk. Red.	100	106 —108
£1,000,000	100	4½%	Do. 4½% 2nd Mort. Debs., Red.	100	106 —108
225,000	1	1/2⅖	Weardale Steel, Coal & Coke, Ltd., Def. Ord.	1	⅝— ⅞
500,000	1	7⅕d.	Do. 6% Cum. Pref. Ord. ..	1	⅞— 1
£300,000	Stk	4%	Do. 4% Perpetual Deb. Stock	100	85 — 89
7,637	5	2/9	Weldless Steel Tube, Ltd., Cum. Pref. 5½	5	4⅜— 4⅞
300	Stk	4½%	Do. Mort. Deb. 4½%	100	91 — 97
66,666	5	3/.	Willans & Robinson, Ord.	5	1½— 2½
66,666	5	3/-	Do. 6% Cum. Pref.	5	3 — 4
£246,641	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red	100	78 — 83
£150,000	Stk	4½%	Yorkshire Iron & Coal Co., Ltd., 4½% 1st Mort. Deb. Stk. Red.	100	81 — 86

Stocks and Shares marked * are quoted ex-dividend.

II.—ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name	Paid up.	Closing Prices.
70,000	1	6d.	Alliance Elec. Co., Ltd. 5% Cum. Pf.	1	⅝— ⅞*
125,000	1	7½d.	Aron Elec. Meter Ltd., 6% Cum. Pf.	1	$\frac{7}{16}$— $\frac{9}{16}$
120,000	1	9⅜d.	Bell's Asbestos Co., Ltd.	1	$\frac{11}{16}$—$\frac{13}{16}$
100,000	5	4/-	British Insulated & Helsby Cables Ltd., Ord. ..	5	5¾— 6¼
100,000	5	3/-	Do. 6% Cum. Pref.	5	5¼—5¾
£500,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Rd.	100	101 —104
£200,000	Stk	4½%	British Thomson-Houston Co., Ltd., 4½% 1st Mort. Deb. Stk. Red. ..	100	99 —101*
400,000	5	3/-	British Westinghouse Electric and Manufac. Co., Ltd., 6% Pref. ..	5	8⅛— 8⅜
£616,353	Stk	4%	Do. 4% Mort. Deb. Stk. Red...	100	91 — 93
105,731	2	2/-	Brush Elec. Enging. Co., Ltd., Ord. .	2	½— ¾
150,000	2	2/4⅘	Do. 6% Pref.	2	1½— 1¾
£125,000	Stk	4½%	Do. 4½% Perp. 1st Deb. Stk...	100	92 — 95*
£125,000	Stk	4½%	Do. 4½% Perp. 2nd Deb. Stk.	100	79 — 82
35,000	5	5/-	Callender's Cable & Constn. Ltd. Ord.	5	11 — 11½
40,000	5	2/6	Do. 5 % Cum. Pref.	5	5½— 5¾
£200,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Red.	100	105 —107
85,000	3	1/6	Crompton & Co., Ltd...	3	2⅛— 2⅜
£100,000	—	5%	Do. 5% 1st Mort. Reg. Debs.	100	93— 98
52,000	5	10/-	Dick, Kerr & Co., Ltd., Ord. ..	5	8 — 8½
61,000	5	3/-	Do. 6% Cum. Pref.	5	5⅞— 6⅛
£300 000	Stk	4½%	Do. 4½% Deb. Stock, Red. ..	100	106 —108
233,334	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	1⅛— 1⅜
£233,334	Stk	4%	Do. 1st Mort. 4% Iree. Deb. Stk.	100	106 —109
99,261	5	1/6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	3	⅞— 1⅛
17,139	5	2/6	Do. "A" Shares Nos. 01-017,139	5	1½— 2
£344.023	Stk	4%	Do. 4% Deb. Stock Red. ..	100	80 — 85
£100,000	Stk	5%	Do. 5% Second Deb. Stk. Red.	100	86 — 91
112,100	2	1/7½	Electric Construction Co., Ltd. ..	2	1⅛— 1¼
31,390	2	2/9⅗	Do. 7% Cumulative Pref. ..	2	2¼— 2½
£200,000	Stk	4%	Do. 4% Perp. 1st Mt. Deb. Stk.	100	97 — 99
10,248	10	7/6	Evered and Co., Ltd...	10	12 — 14
£100,000	Stk	5%	Ferranti, Ltd., 5% 1st Mort. Deb. Stock, Red...	100	90 — 95
25,000	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9½— 10
£200,000	Stk	4%	Do. 4% 1st. Mt. Deb. Stk., Red.	100	91 — 96
35,000	5	5/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	13 —13½
35,000	5	2/3	Do. 4½% Cum. Pref... ..	5	5⅜— 5⅝*
£50 000	Stk	4½%	Do. 4½% Mt. Deb. Stk. Red.	100	109—111*
50,000	10	5/-	India Rubber, Gutta Percha & Telegraph Works Co., Ltd.,	10	16 — 17
£300,000	100	4%	Do. 1st Mort. Deb. Red. ..	100	100 —103
7,500	10	—	Parker, Thos., Ltd.	10	6½— 7
100,000	1	3%	Scott (Ernest) & Mountain, Ld., Ord.	1	16/-—17/-
37,350	12	12/-	Telegraph Construction and Maintenance Co., Ltd.	12	36 — 38
£150,000	100	4%	Do. 4% Deb. Bonds	100	103 —105

III.—ELECTRIC TRACTION.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
120,000	5	3/-	Anglo-Argentine Trams Co., Ld., Or.	5	8⅜— 8⅝
260,007	5	2/6	Do. 5% Cum Pf.	5	5⅝— 5⅞
£230,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888 ..	100	140 —143
20,000	10	6/-	Barcelona Trams Co., Ltd., Ord. ..	10	12 — 12½
10,000	10	5/-	Do. 5% Cum Pf. Shares	10	9 — 10
£46,300	100	5%	Do. 5% Debs., Red. ..	100	99 —102
£191,326	Stk	4½%	Do. 4½% Red. Deb. Stk.	100	96 —100
75,606	1	—	Bath Elec. Trams, Ld., Pf. Or. ..	1	¾ — ⅞
59,394	1	11·49d	Do. 5% Cum. Pf. ..	1	$\frac{15}{16}$— 1$\frac{1}{16}$
75,000	5	—	Brisbane Electric Tram Investment Co., Ltd., Ord... ..	5	1¼— 1¾
75,000	5	2/6	Do. 5% Cum. Pf. ..	5	3¾— 4¼
£425,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	94 — 98
£200,000	Stk	6%	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	103 —106
		%	Pref. Ord. Stock	100	100 —103
133,301	10	6/-	Brit. Electric Traction, Ltd., Ord.	10	9¼— 9¾
156,437	10	6/-	Do. 6% Cum. Pref.	10	10⅞—11⅛
£1,000,000	Stk	5%	Do. 5% Perp. Deb. Stk. ..	100	121 —123
£250,000	Stk	4½%	Do. 4% 2nd Deb. Stk. Red..	100	97 — 99
100,000	5	1/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	3¾— 4
40,500	5	3/-	Do. "A" 6% Cum Pref. ..	5	5⅜— 5⅞
27,000	5	3/-	Do. "B" do.	5	5⅜— 5⅝

ELECTRIC TRACTION.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£200,000	Stk	5%	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	95 — 98
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	103 —106
102,268	5	3/-	Calcutta Tramways Co., Ltd. ..	5	8¾— 9
£350,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	106 —108
480,000	1	6d.	Cape Electric Tramways, Ltd. ..	1	1¼— 1½
40,000	5	2/6	City of Birmingham Trams Co., Ltd. 5 % Cum. Pref.	5	4⅞— 5⅛
£300,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	101 —104
£120,000	Stk	5%	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	101 —104
60,000	10	6/-	Dublin United Trams. Co. (1896), Ltd., Ord. ..	10	13 — 14
59,987	10	6/-	Do. 6% Pref...	10	15½— 16½
30,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	3 — 3½*
£150,000	Stk	4%	Do. 4% Deb. Stock.. ..	100	89 — 92
125.000	10	5/-	London United Trams. (1901), Ltd., 5% Cum. Pref.	10	10 —10½
£1.031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	99 —102
£50,000	Stk	5%	Madras Electric Trams (1904), Ltd., 5% Deb Stock, Red.	100	101 —103
314,016	1	—	Metropolitan Elec. Trams, Ltd., Def.	1	$\frac{13}{32}$—$\frac{15}{32}$
500,000	1	6d.	Do. 5% Cum. Pref... ..	1	$\frac{15}{16}$— 1
£350,000	Stk	4½%	Do. 4½% Deb. Stock, Red.	100	105 —107
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	½— 1½
110,923	8	3/2⅗	North Metropolitan Tramways Co..	8	4 — 4½*
£150,000	100	3½%	Do. 3½% Mort. Debs.	100	90 — 95
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red..	100	104 —107
24,500	10	10/-	Potteries Elec. Traction Co., Ld., Or.	10	9¼— 9¾
24,500	10	5/-	Do. 5% Cum. Pref. ..	10	9 — 9½
£220,000	Stk	4½%	Do. 4½% Deb. Stk., Red.	100	102 —105

IV.—ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
7,500	10	16/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. ..	10	12¼— 12¾
7,500	10	4/6	Do. 4½% Cum. Pref. ..	10	9¾— 10¼
7,500	10	6/-	Do. 6% Cum. Second Pf. ..	10	11 — 12
£70,000	Stk	4½%	Do. 4½% Deb. Stock Red ..	100	105 —107
14,000	5	2/-	Bromley (Kent) Elec. Lt. & Pr. Co. Ld	5	5¼— 5¾
£50,000	Stk	4½%	Do. do. 4½% 1st Deb. Stk. Red.	100	101 —104
27,507	5	4/6	Brompton & Kensington Elec. Supply Co., Ltd. Ord. ..	5	10¼— 10¾
12,493	5	3/6	Do. 7% Cum. Pref. Shares..	5	10¼— 10¾
60,000	5	3/-	Calcutta Elec. Sup. Cor. Ltd., Ord..	5	9 — 9¼
£288,782	Stk	4%	Central Elec. Sup. Co., Ltd., 4% Gua. Deb. S k. ..	100	105 — 108
70,000	5	4/-	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord... ..	5	8 — 8½*
80,000	5	2/3	Do. do. 4½% Cum. Pref...	5	5½— 5¾
£350,000	Stk	4%	Do. do. 4% Deb. Stk. Red.	100	103 —105
44,436	5	3/9	Chelsea Elec. Sply. Co., Ltd., Ord.	5	6¾— 7¼*
£150,000	Stk	4½%	Do. do. 4½% Deb. Stk., Red	100	109 —111
70,595	10	5/-	City of London El. Lghtg. Co., Ld., O.	10	12½— 13
40,000	10	6/-	Do. 6% Cum. Pref.	10	13¾— 14¼
£400,000	Stk	5%	Do. 5% Deb. Stk., Red ..	100	123 —127
£300,000	Stk	4½%	Do. 4½% 2nd Deb. Stk., Red	100	103 —105
40,000	10	4/-	County of London Elec Supply Co., Ltd., Ord.	10	9½— 10
30,000	10	6/-	Do. 6% Cum. Pref.	10	12¼— 12¾
£400,000	Stk	4½%	Do. 4½% Deb. Stk., Red. ..	100	110 —113
70,000	5	2/6	Edmundson's Elec. Cor. Ltd., Ord.	5	6¼ — 6¾
70,000	5	3/-	Do. 6% Cum. Pref.	5	6⅛— 6⅝
£300,000	Stk	4½%	Do. 4½% 1st Mort. Db. Stk. Reg	100	106 —108
£80,000	Stk	5%	Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. Stk. Red.	100	86 — 91
10,000	5	2/-	Folkestone Elec. Supply Co., Ld., O.	5	5½— 6
£50,000	Stk.	4½%	Do. 4½% 1st Deb. Stk., Red.	100	101 —104
15,000	10	—	Havana Electricity Co., Ltd... ..	10	9½—10½
13,000	5	3/6	Hove Elec. Lighting Co., Ltd., Ord.	5	7½— 8
£50,000	Stk	4½%	Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock, Red.	100	101—103
150,000	1	—	Kalgoorlie Electric Power & Lighting Corp, Ltd., 6% Cum. Pref.	1	⅝— ⅞
21,000	5	7/-	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord. ..	5	12¾—13¼*

Stocks and Shares marked * are quoted ex-dividend.

ELECTRIC LIGHTING AND POWER.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£135,000	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	102 —104
111,000	3	1/9⅜	London Elec. Supply Corp., Ld., Ord.	3	2 9/16—2 13/16*
60,000	5	3/-	Do. 6% Pref.	5	5¾ — 6*
£371,895	Stk	4%	Do. 4% 1st Mort. Db. Stk., Red.	100	99 —101
100,000	10	9/-	Metropolitan Elec. Sup. Co., Ld., Or.	10	19¼— 19¾
76,121	5	2/3	Do. 4½% Cum. Pref.	5	5⅝ — 5¾
220,000	Stk	4½%	Do. 4½% 1st Mort. Db. Sk., Red.	100	110 —115
250,000	Stk	3½%	Do. 3½% Mort. Deb. Stk., Red.	100	97 — 99
£250,000	—	4½%	Midland Elec. Corp. for Power Distribution, Ld., 4½% 1st Mort. Deb.	100	97 —100
10,852	10	6/-	Notting Hill Elec. Ltg. Co. Ltd. Ord.	10	14½— 15
£59,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	102 —104
16,500	5	2/6	Oxford Electric Co. Ltd., Ord. ..	5	6¼— 6½
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	98 —100
£84,700	100	4½%	Royal Elec. Co. (of Montreal) 4½% 20-yr. 1st Mort. Deb	100	100 —102
40,000	5	9/6	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	13¾—14¼*
20,000	5	3/6	Do. 7% Pref.	5	8¼— 8¾*
£150,000	Stk	3½%	Do. 3½% Deben. Stock, Red	100	98 —100
12,000	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2⅝— 3⅛*
£50,000	Stk	4%	Do. 4% Debenture Stk Red.	100	79 — 83
65,000	5	3/-	South London Elec. Sup. Co., Ltd. O.	5	4¼— 4½
100,000	1	—	South Metropolitan Elec Light & Power Co., Ltd. Ord.	1	⅞ — 1
50,000	1	8⅜d.	Do. 7% Cum. Pref.	1	1 1/16—1 3/16
£100,000	Stk	4½%	Do. 4½% 1st Deb. Stock Red.	100	107 —110
50,000	5	2/6	Urban Electric Supply Co., Ltd., O.	5	5 1/16—5 3/16
30,000	5	2/6	Do. 5% Cum Pref.	5	5⅛— 5¼
£200,000	Stk	—	Do. 4½% 1st Mort. Deb. Stk. Red	100	106 —108
110,000	5	7/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	12¾—13¼*
28,151	5	2/6	Do. 5% Cum. Pref.	5	6¼— 6¾

V.—TELEGRAPH & TELEPHONE COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£34,800	100	4%	African Direct Tel. Co., Ld., 4% Mt. Debs. (Series A), Red.	100	99 —102
25,000	10	—	Amazon Telegraph Co., Ld... ..	10	2¼ — 2¾
£763,580	Stk	17/6	Anglo-American Tel. Co., Ltd., Ord.	100	61 — 63
£3,118,210	Stk	35/-	Do. 6% Preferred Ordinary	100	108½—109½
£3,118,210	Stk	2/-	Do. Deferred Ordinary ..	100	16½—16¾
44,000	5	3/-	Chili Telephone Co., Ltd.	5	6⅝— 6⅞
$15,000,000	$100	$2	Commercial Cable Co., Capital Stk.	$100	230 —240
£1,903,856	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	97 — 99
16,000	10	5/-	Cuba Submarine Tel. Co., Ld., Ord.	10	8¾— 9¼
6,000	10	10/-	Do. 10% Preference	10	17 — 18
6,000	5	2/-	Direct Spanish Telegraph Co., Ord.	5	3⅝— 3⅞
		5/-	10% Cum. Preference	5	8¼— 8¾
£30,000	50	4½%	Do. 4½% Debs...	50	101-103%
60,710	20	3/-	Direct U.S. Cable Co., Ltd... ..	20	11⅜—11⅝
£85,800	100	4½%	Direct West India Cable Co., Ltd., 4½% Reg. Debs.	100	100—102
£300,000	100	4%	East. & S. African, Ld., 4% Mt. Dbs.	100	100—102
£200,000	25	4%	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)..	25	101-103%
300,000	10	2/6	Eastern Extension, Australasia and China, Ltd...	10	14½— 15
£602,400	Stk	4%	Do. 4% Mort. Deb. Stk., Perp.	100	105 —107
£4,000,000	Stk	25/-	Eastern Tele. Co., Ltd., Ord. ..	100	145 —148
£2,000,000	Stk	17/6	Do. 3 % Pref.	100	92 — 94
£1,836,814	Stk	4%	Do. 4% Mort. Deb.	100	106 —108
150,000	10	5/-	Great Northern Telegraph Co., Ltd., (of Copenhagen) ..	10	32½— 33½
£58.700	100	4½%	Halifax and Bermudas Cable Co., Ltd., 4½% 1st. Mort. Debs. Red.	100	100—102
17,000	25	12/6	Indo-European Tele. Co., Ltd. ..	25	46½— 48½
72.680	1	7½d.	Monte Video Telephone Co., Ltd., O.	1	13/16— 15/16
£1,983,333	Stk	6%	National Telephone Co., Ltd., Pref.	100	112½—113½
£1,966 667	Stk	5%	Do. Deferred	100	106—108
250,000	5	2/6	Do. 5% Non-Cum. 3rd Pref.	5	5½ — 5¾
£2,000,000	Stk	3½%	Do. 3½% Deb. Stk., Red. ..	100	100—102
£689,593	Stk	4%	Do. 4% do. do. ..	100	101 —106
179,313	1	7½d.	Oriental Telephone & Elec. Co., Ltd.	1	1¼ — 1⅜
50,000	1	7½d.	Do. 6% Cum. Pref.	1	1 3/16 — 1 5/16
£100,000	100	4%	Pacific & European Tel. 4% Guar. Debs. Red...	100	98 —101
11,839	8	4/-	Reuter's Telegram Co., Ltd. ..	8	7¼ — 7¾
58,000	5	3/-	United River Plate Telep. Co., Ltd.	5	7¼— 7¾
40,000	5	2/6	Do. 5% Cum. Pref.	5	5 — 5¼
£179,947	Stk	5%	Do. 5% Deb. Stock, Red. ..	100	106—108
15,609	10	4/-	W. African Telegraph Co., Ltd. ..	10	8 — 8½
£30,008	2½	—	West Coast of America, Ltd. ..	2½	5/16— 7/16
150,000	100	4%	Do. 4% Deb. Guar. by West. Tel.	100	100 — 102

TELEGRAPHS AND TELEPHONES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name	Paid up.	Closing Prices.
88,321	10	6d.	W. India & Panama Teleg. Co., Ld., Or.	10	⅞— 1
34,563	10	6/-	Do. 6% Cum. 1st. Pref. ..	10	8½— 9
4,669	10	6/-	Do. 6% Cum. 2nd Pref. ..	10	8¼ — 8¾
£80,000	100	5%	Do. 5% Deb.	100	103 —105
207,930	10	3/-	Western Telegraph Co., Ltd. ..	10	13¾— 14¼
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	101 —103
518,915	Stk	4%	Do. 4% Deb. Stock, Red. ..	100	103 —105

VI.—SHIPPING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
32,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 5½% Cum. Pref.	10	8½— 9
£325,000	Stk	4½%	Do. 4½% Red. 1st Mort. Deb. Stk.	100	99 —101
£672,900	Stk	4½%	British & African Stm. Nav. (1900) Ltd., 4½% 1st Mort. Deb. Stk. Red.	100	93 — 95
40, 000	10	5/6	Bucknall Steamship Lines, Ltd., 5½% Cum. Pref.	10	6 — 6½
£600,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk.	100	75 — 78
£750,000	Stk	4½%	Clan Line Steamers, Ltd., 4½% Deb. Stk. Red. ..	100	98 —100
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000..	20	13¾ - 14¼
40,000	20	8/-	Do. Nos. 60,001-100,000	10	5½— 6
£461,430	Stk	4½%	Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. ..	100	101 —103
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord...	1	1 3/16—1 5/16
25,328	7½	4/7	Gen. Steam Navigation Co., Ld., Ord.	7½	4¼— 4¾
36,758	8	4/9⅜	Do. Non-Cum. 6% Pref... ..	8	7½— 8
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	99 —101
55,000	5	1/3	Houlder Line, Ltd., Ord.	5	2½— 3
40,000	5	2/9	Do. 5½% Cum. Pref.	5	3¼— 3¾
£200,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk. Red.	100	83 — 86
141,500	10	5/-	Leyland (Fredk.), & Co. (1900), Ltd., 5% Cum. Pref. ..	10	5¼ 5¾
£1,160,000	Stk	5 %	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. ..	100	131 —134
£1,160,000	Stk	19%	Do. do. Deferred ..	100	225 —228
15,000	100	30/-	Royal Mail Steam Packet Co. Ord..	60	25½ — 26½
39,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref..	5	4¾— 5¼
39,075	5	2/6	Do. "B" Ord...	5	4 — 4½
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord..	10	8¼— 8¾
24,000	10	4/6	Do. 4½% Cum. Pref... ..	10	10 — 10½
£1,008,894	Stk	4%	Do. 4% Debenture Stk., Red.	100	99 —101

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
60 000	1	9⅜d.	Chadburn's (Ship) Tele. Ltd., Ord...	1	⅞— 1⅛
£750,000	Stk	5%	General Hydraulic Power Co., Ltd.	100	133 —138
12,500	10	10/-	Oakey (John) and Sons, Ltd., Ord..	10	24 — 26
10,000	10	6/-	Do. do. 6% Cum. Pf.	10	14 — 15
183,538	1	6·3d.	Power Gas Corp., Ltd., Ord., Nos. 66,463-250	15/-	5/16— 7/16
66,462	1	8·4d.	Do. do. Nos. 1 66,462	1	9/16— 11/16
135,000	1	6d.	Waygood (R.) & Co., Ltd., Ord. ..	1	1 1/16— 1 3/16
135,000	1	7½d.	Do. 6% Cum. Pref. ...	1	1⅛— 1¼

RAILWAY CARRIAGE & WAGON COMPANIES.

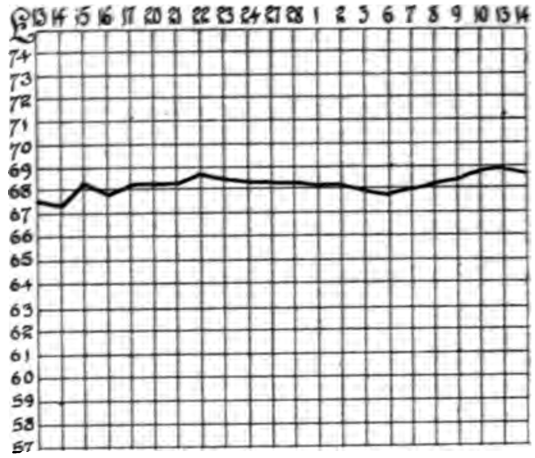
Present Amount Subscribed,	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
10,000	10	7/6	Birm. Railway-Car, & Wagon, L., 1-10,000	10	21 —22*
8,739	10	3/-	Do. Second Issue 1-8,739....	4	8¾— 9*
10,000	10	6/-	Do. Cum. Pref. 6% 1-10,000..	10	13 —13¼*
30,111	7	7/-	Gloucester Rail.-Car & Wagon, Ld., A, 1-29,861 & 49,751-50,000	7	9⅛— 9⅝
44,889	7	3/6	Do. B, 29,862-49,750, 50,001-75,000	7	4 — 4⅛
14,567	10	1/3	Lancashire Wagon, Ord.	2	2 3/16—2 5/16
4,150	10	5%	Do. do.	10	10½—10¾
784,808	1	9d.	Metropolitan Amalgamated Rail.-Carriage & Wagon, Ld., 1-784,808	1	41/6—42/6
164,288	1	6d.	Do. Cum. A Pref. 5% 1-164,288	1	23/6—24/6
235,000	1	7½d.	Do. Cum. B Pref. 6% 1-235,000	1	27/6—28/6
20,000	20	20/-	Midland Rail.-Car. & Wagon, Ld., 1-20,000	10	19 —19½

Stocks and Shares marked * are quoted ex-dividend.

THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM FEBRUARY 13TH TO MARCH 14TH, 1905.

COPPER.



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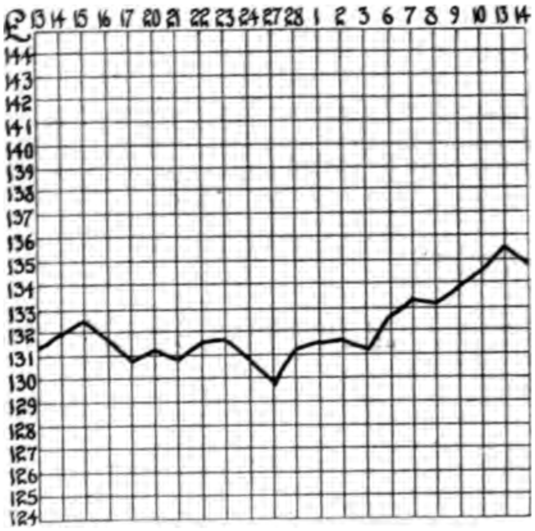
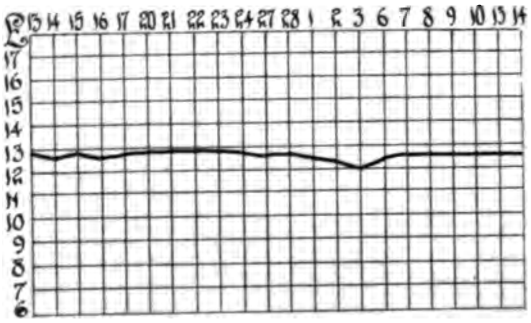
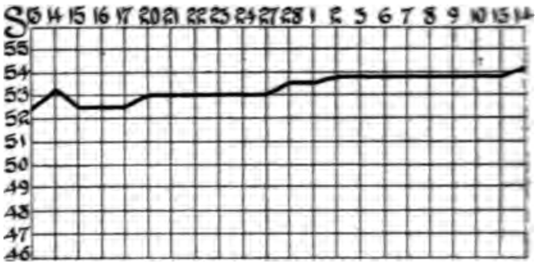


ENGLISH LEAD.



PIG IRON: SCOTCH,



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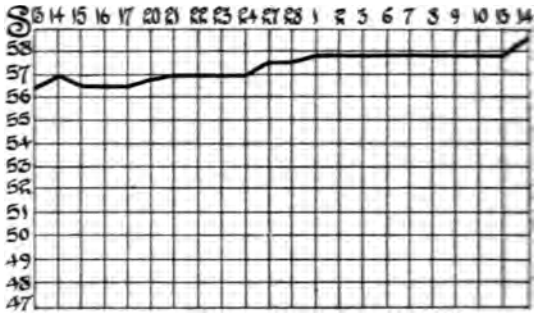
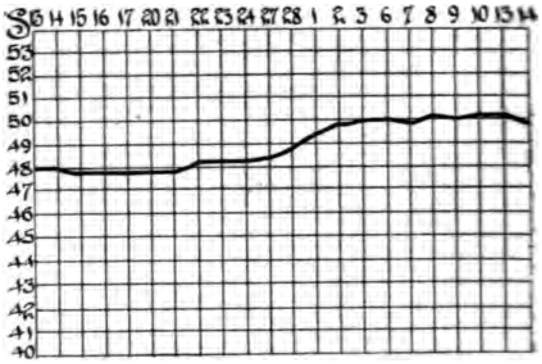


CLEVELAND.



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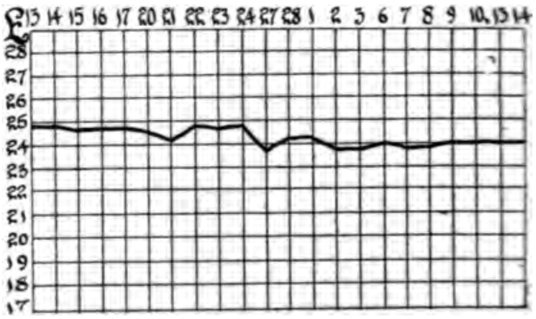


PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

MARKET REPORT.

Wednesday, March 15th, 1905.

COPPER as predicted, has improved, notwithstanding a good deal of selling on each advance. Advices from the United States show the market there to be in a strong position, most producers being well booked for forward delivery, and operators are beginning to realise that the moment is opportune for manipulative tactics. There is no gainsaying the fact that the bear party is growing uneasy owing to the steady support forthcoming for forward metal. Business yesterday was on a fair scale and the market closed at £68 10s. od. cash and £68 18s. 9d. three months, and it is quite on the cards that the next few days will see copper touch £70.

The announcement chronicled in our last issue, that the Dutch Government had decided to reduce the quantity of Banca tin, to be offered by auction during the remainder of the year, has had the effect of lifting the price of tin by nearly £4 per ton as compared with the lowest prices of ten days since. It is true that the smaller quantity to be offered at the Banca sales constitutes no great reduction in itself, and it is only when it is viewed in the light of the very small visible supplies, and the constantly increasing consumption that its real significance becomes apparent. America has again sent buying orders into the market, and the quotation closed strong at £135 cash, and £133 7s. 6d. three months.

The Lead market shows a decided improvement, orders having been placed more freely, so that the price which at one time was £11 18s. 6d. for spot metal has advanced Foreign prompt £12 6s. 6d., English £12 7s. 6d.

Spelter has advanced in sympathy with the general upward trend of the metal market, and the final quotations are £24 Ordinaries, and £24 8s. 6d. Specials.

The home iron and steel market continues to be dominated by the American situation, speculators on this side taking their cue from the intelligence which is cabled over. The position is practically unchanged, it still being believed that the present output of pig-iron, notwithstanding that it beats all records, will be insufficient to meet the demand, and on the expectation of exports from this side, the prices of Middlesbrough and other standard brands have risen sharply.

IRON, STEEL, PIG-IRON, &c.

SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as follows. Prices delivered in Glasgow or equal:—

Steel:

		£	s.	d.
DALZELL	Siemens' Steel Plates, Marine Boiler Quality ..	6	15	0
♛♛	,, ,, ,, Land ,, ,, ...	6	17	6
STEEL	,, Steel Bars, Boiler Quality	6	17	6
DALZELL	Siemens' Steel Plates, Ship Quality Plates......	5	17	6
♛	,, ,, Bars ,, ,, ...	6	7	6
STEEL	,, ,, Angles...............................	5	7	6

Manufactured Iron:

	£	s.	d.
Bars—Dalzell	6	2	6
,, Best	6	12	6
,, ,, Horseshoe	6	12	6
,, Angle..	6	2	6
,, Best Angle	6	12	6
,, Best Best	7	2	6
,, Extra Best	7	12	6

Usual terms and extras. Special rates for delivery in England and export. The above prices subject to alteration without notice.

The Glasgow Iron and Steel Co., Ltd., Wishaw, quote as under (prices are delivered Glasgow or equal):—

	£	s.	d.	
Steel Angles (Glasgow ♛ Steel)	5	7	6	per ton.
Steel Ship Plates (Glasgow ♛ Steel)	5	17	6	,,
Steel Bars, Ship Quality (Glasgow ♛ Steel)	6	7	6	,,
Steel Bars, Boiler Quality (Glasgow ♛ ♛ Steel)	6	17	6	,,
Steel Land Boiler Plates (Glasgow ♛ ♛ Steel)	6	7	6	,,
Steel Marine Boiler Plates (Glasgow ♛ ♛ Steel)	6	7	6	,,

Less 5 per cent. d'scount. Extras as per standard list.

Special prices for delivery in England and for export. The above prices subject to alteration without notice.

John Spencer (Coatbridge), Ltd., Phœnix Ironworks, Coatbridge, N.B., quotes:—

	£	s.	d.
Bars—Phœnix	6	5	0
,, Best	6	15	0
,, Best Best	7	5	0
,, Extra Best.......................................	7	15	0
,, Best Horse Shoe	6	15	0
,, Extra B.H.S.	7	15	0
,, Extra Best Cable	8	5	0
,, Rivet	6	5	0
,, Best Scrap Rivet	7	5	0

	£	s.	d.
Angles—Phœnix	6	5	0
,, Best	6	15	0
,, Extra Best	7	5	0
Gas Tube Hoops—Phœnix Best	6	15	0
Plates—Phœnix	—		
,, Best Boiler	7	10	0
,, Best Best Boiler	8	0	0
,, Extra Best Boiler	9	0	0
Boiler Tube Strips—Phœnix Best Best	8	0	0

All per ton, delivered f.a.s., Glasgow, Greenock, Grargemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly.

Messrs. R. Feldtmann and Co., of Glasgow, quote Commission extra).

Pig Iron:

	No. 1.			No. 3.		
	£	s.	d.	£	s.	d.
Coltness, f.a.s. Glasgow	3	4	6	2	14	0
Gartsherrie ,,	2	19	0	2	14	0
Summerlee ,,	2	19	0	2	14	0
Carnbroe ,,	2	16	6	2	12	6
Langloan ,,	3	4	0	2	15	0
Calder ,,	2	19	0	—		
Clyde ,,	2	18	6	2	13	6
Glengarnock, f.o.b. Ardrossan	2	18	0	2	12	6
Eglinton ,, ,,	2	14	6	2	12	6
Dalmellington, ,, Ayr	2	14	6	2	12	6
Shotts ,, Leith	2	19	0	2	14	6

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, **at works**:—

	£	s.	d.
W.W. Bars	6	12	6
W.W. Best Bars	7	2	6
W.W. Best Best	7	12	6
W.W. Best Best Best	8	2	6
W.W. Best Shoe	7	2	6
Thornaby	8	2	6
Thornaby Best	8	12	6
Thornaby Best Best	9	12	6
Whitwell Special Admiralty Cable	10	5	0
Special Chain Iron	9	5	0
Tube and Nail Strips	6	15	0
W.W. Angle Iron	6	15	0
W.W. Best Angle Iron	7	5	0
Tee Iron, to 8-inches United	7	12	6

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington, quote:—

		Iron.			Steel.		
		£	s	d.	£	s.	d.
	Bars	6	10	0	7	5	0
	Angles	7	0	0	7	5	0
	Tees	7	10	0	7	15	0
	Hoops	7	0	0	7	10	0
W.I.W	Sheets	7	10	0	8	0	0

Ordinary Sizes, F.A.S. Liverpool in 10-ton Lots.
Extras for Sizes and Cutting as per List.

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

	Singles 20 G 96in. by 36in. per ton.			Doubles 21 G to 24 G 96in. by 36in. per ton.		
Black Sheets:	£	s.	d.	£	s.	d.
"Vale"	10	0	0	10	10	0
"Shield"	10	10	0	11	10	0
"Severn"	11	10	0	12	10	0
"Baldwin Wilden B."	12	10	0	13	10	0
Charcoal	16	10	0	17	10	0
Best Charcoal	18	10	0	19	10	0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:

	£	s.	d.	£	s.	d.
No. 3 Lead	13	10	0	14	10	0
S.V. Lead	15	0	0	16	0	0
No. 3 Terne	15	0	0	16	0	0
S.V. Terne	16	10	0	17	10	0

	Singles 20 G to 108 by 36in. per ton.			Doubles 21 to 24 G to 96 by 36in. per ton.		
Tinned Sheets:	£	s.	d.	£	s.	d.
Best Coke (Finish)	28	0	0	29	10	0
,, Charcoal (Finish)	30	0	0	31	10	0
Extra ,, ,,	32	0	0	33	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.

Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box.

Extreme sizes in Tin and Patent Coated specially quoted for.

Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.

At works less 2½% for cash monthly, 10th inst.

Galvanized Corrugated Sheets:

	£	s.	d.	
"Phœnix" Brand, 24 G., f.o.b. London, in Bundles	11	12	6	per ton.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	14	5	0	,,

Galvanized Working Up-Sheets:

	£	s.	d.	
24 G., f.o.b. London, in Bundles	13	15	0	per ton.

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£	s.	d.	
Crown Bars	6	10	0	per ton.
Best Bars (1 to 6in. wide, above ¼ in. thick, ½ in. to 4 rounds and squares)	7	0	0	,,
Angles	6	15	0	,,
,, Best	7	5	0	,,
T's	7	0	0	,,
,, Best	7	10	0	
Best Shoe Iron	8	0	0	
,, Rivet Iron	8	0	0	
,, Best Rivet (Special)	9	5		
,, Cable	9	5		
,, Screwing	8	5		

	£	s.	d.	
Best Turning	8	0	0	per ton.
,, Plating	8	5	0	,,
Best Best	9	5	0	,,
Treble Best	10	5	0	,,
Plates	7	10	0	,,
Best Plates	8	0	0	,,
,, Boiler Plates	8	10	0	,,
,, Best Boiler Plates	9	10	0	,,
Treble Best Boiler Plates	12	0	0	,,

Delivery f.o.b. Liverpool, Birkenhead or Manchester.

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon., quote "Star" brand patent wrought nails, steel nails, &c.

Discounts—

45 per cent. off 1-inch to 3-inch strong rose and all fine rose and 6dy. and 8dy. pound.

40 per cent. off 3½ inch to 7-inch strong rose and 10dy. and 20dy. pound.

40 per cent. off all sharp-pointed nails.

Delivered in lots of 4 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis :—
2 tons 9/6 per cwt.
4 cwt. lots and upwards 9/9 per cwt. } d/d any Railway Station.

Steel cut nails, 3-inch basis—
2 tons 8/3 per cwt.
4 cwt. lots 8/6 per cwt. } d/d any Railway Station.
Slit rods (iron) £7 10s. per ton, at works for 2-ton lots.

Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E. C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla, quote :—

	Per Box. f.o.b. Wales. £	s.	d.
Coke Tin-plates.			
C 18¾ by 14 124s. 110 lb. "BV"	0	12	3
C 20 by 10 225s. 155 ,, "Jumbo"	0	17	3
C 20 by 14 112s. 108 ,, "Lydbrook"	0	12	0
C 28 by 20 112s. 216 ,, "Lydbrook"	1	4	3
Charcoal Tinplates :			
C 20 by 14 112s. 108 lb. "Allaway"	0	12	9

BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes :—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

	£	s.	d	
Steel :				
Blooms	at 3	12	0	per ton.
Billets	at 3	14	0	,,
Sheet Bars	at 3	16	0	,,
Finished Steel :				
Bars	at 5	0	0	per ton.
Angles	at 5	1	0	,,
Tees	at 5	4	0	,,
Joists	at 4	10	0	,,
Fencing Standards	at 5	2	0	,,
Shoeing Bars	at 5	4	0	,,
Tyre Bars	at 5	4	0	,,
Half-Round Bars	at 5	5	0	,,
Heavy Rails	at 4	15	0	,,
Light Rails	at 4	17	6	,,

Structural Steelwork :

Prices on application.

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote :—

TIN.

Tin :	£	s.	d.		£	s.	d.	
English Ingots, f.o.b. Dis. 1¼% & 1%	135	0	0	to	135	10	0	per ton.
English Bars, f.o.b. Dis. 1¼% & 1%	136	0	0	to	136	10	0	,,
Straits G.M.B., cash Warehouse, Net	135	2	6	to	135	5	0	,,
Straits G.M.B., 3 months, Warehouse, Net	134	2	6	to	134	5	0	,,
Australian, Mt. Bischoff, Warehouse, Net	135	2	6	to	136	2	6	,,

COPPER.

Copper :	£	s.	d.		£	s.	d.	
Standard G.M.B., cash Warehouse, Net	68	15	0	to	68	17	6	per ton.
Standard G.M.B., 3 months, Warehouse, Net	69	0	0	to	69	2	6	,,
English, Tough, Cake & Ingot, Warehouses, Net	71	5	0	to	71	15	0	,,
English, Best Select, Warehouse Net	72	10	0	to	73	0	0	,,
English, Sheets and Sheathing, f.o.b., Dis. 2½%	80	0	0	to	80	10	0	,,
English Sheets for India, f.o.b., Dis. 2½%	76	0	0	to	76	10	0	,,
Electro, Warehouse, Net	70	15	0	to	71	0	0	,,
Ore, ex. ship	0	12	0	to	0	13	0	per unit.
Regulus, Matte and Precipitate, ex. ship,	0	13	3	to	0	14	0	,,

YELLOW METAL.

Yellow Metal :	£	s.	d.	£	s.	d.	
Sheets, 4 by 4 feet for India f.o.b. Dis. 2½%				0	0	6⅜	per lb.
Sheathing ,, ,,				0	0	6⅛	,,

SPELTER.

	£	s.	d.		£	s.	d.	
Silesian outports, Net	24	0	0	to	24	5	0	per ton
Blende of 50 % Net	6	11	6	to	6	15	0	,,
Calamine, Net	6	14	0	to	6	15	0	,,

LEAD.

	£	s.	d.		£	s.	d.	
English Pig, Warehouse, Dis. 2½%	12	10	0	to	12	15	0	per ton.
Spanish, ex ship, Dis. 2½%	12	6	3	to	12	7	6	,,
Lead Ore of 70 %, Net	6	2	6	to		--		,,

ANTIMONY.

	£	s.	d.		£	s.	d.	
Star Regulus, f.o.b , Dis. 2½ %	35	10	0	to	36	10	0	per ton.
Ore, 50 %, ex ship, Dis. 2½%	8	10	0	to	9	10	0	,,
Crude, ex ship, Dis. 2½ %	14	0	0	to	15	0	0	,,

QUICKSILVER.

	£	s.	d.	
Spanish, 75 lb., Warehouse, Net	7	12	6	per flask.
Italian ,, ,, ,,	7	11	6	,,

COAL.

LEICESTERSHIRE.

The Nailstone Colliery Company, Leicester, quote. Price per Ton at Pit of 20 Cwt., with ½ Cwt. per Ton for wastage —

Upper Main Seam.	s.	d.
Main Coal	7	6
Best Hard Steam (hand picked, as used by the Railway Companies)	6	0
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)	6	0
Fine Slack	0	6

Terms, net cash on 10th of month following delivery.

DERBYSHIRE.

The Manners Colliery Co., Ltd., of Ilkeston quote as follows, per ton at pit:

Kilburn Coal:	s.	d.
Best London Brights	9	9
Large Nuts (1½ to 3½)	9	6
Small Nuts (¾ to 1½)	6	0
Rough Brights	6	0
Peas (⅜ to ¾)	5	0
Slack	3	6
Smudge	2	0

Low Main (or Tupton) Coal:

Low Main Brights	7	6
,, ,, Nuts	7	3
Hards (Good Steam Coal)	8	0
Bakers' Nuts (1" to 2")	6	6
Slack	3	6

The Clay Cross Company's Collieries, Clay Cross, near Chesterfield, quote:—

	per ton at pit. s.	d.
Best Main Coal	10	6
Best Silkstone	10	0
Best House Coal	8	6
Best House Nuts	8	0
Treble Screened Cobbles	7	9
Best Cobbles	7	3

NOTTINGHAMSHIRE.

The Digby Colliery Co., Ltd., near Nottingham, quote per ton at pit:—

Digby Coal:

STEAM.	s.	d.
Best Hand Picked Hard	9	0
Steam Hard	7	9
Hard Nuts	7	0

Gedling Colliery.

HIGH HAZEL.		
London Brights, 4 to 8 in. cube	12	0
Large Nuts, 2 to 4 in. cube	9	6
Small Nuts, ¾ to 2 in. cube	5	6

STEAM.—TOP HARD.		
Best Hard	9	0
Hard Steam	8	0
Cobbles	7	0

CHEMICALS AND OILS.

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square, Manchester, quote:

	£	s.	d.	
Acids: Oxalic	0	0	2¼	per lb.
Picric, Crystals	0	0	11	,,
Tartaric at Manchester	0	0	10⅞	,,

	£	s.	d.	
Acetate of Lime: Brown at Manchester net	9	10	0	per ton
Grey ,,	11	10	0	,,
Alumina: Alum, Lump, loose	5	5	0	,,
,, ,, in casks	5	7	6	,,
,, Ground, in bags	5	15	0	,,
Sulphate of Alumina, 14%	4	10	0	,,
Ammonia: Carbonate	0	0	3⅝	per lb.
Muriate Grey f.o.b. Liverpool	24	0	0	per ton
Sal-ammoniac, Lump, 1sts, del$^{d.}$ U.K.	42	0	0	,,
,, ,, 2nds, ,,	40	0	0	,,
Sulphate f.o.b. Liverpool	12	15	0	,,
Arsenic: Best White Powdered net	12	7	6	,,
Bleaching Powder, 35% ,,	4	10	0	,,
Borax: British Refined Crystal ,,	12	0	0	,,
Coal Tar Products:				
Benzole, 50/90 % ,,	0	0	6	per gal.
,, 90% ,,	0	0	7	,,
Carbolic Acid Crystals, 34/35° C. ,,	0	0	6	per lb.
,, ,, ,, 39/40° C. ,,	0	0	6¼	,,
,, ,, Liquid, 97/99 % ,,	0	0	9	per gal.
,, ,, Crude, 62½% at 60° F. f.o.b. ,,	0	1	9	,,
Creosote, ordinary good liquid ,,	0	0	1¼	,,
Naphtha, Crude, 20 % at 120° C. ,,	0	0	3	,,
,, Solvent, 90% at 160° C. f.o.b ,,	0	0	8	,,
,, ,, 95 % at 160° C. ,, ,,	0	0	9	,,
,, ,, 90 % at 190° C. ,, ,,	0	0	10	,,
,, Rectified, flash point over 73° F. f.o.b. ,,	0	0	11	,,
,, Rectified, flash point over 100° F. f.o.b. ,,		1	0	,,
Naphthalene, all qualities.				
Pitch f.a.s. Manchester. ,,	1	11	6	per ton.
Copperas: Green, in bulk ,,	0	12	6	,,
,, barrels f.o.b. L'pool ,,	1	19	0	,,
Cake ,,	1	2	6	,,
Copper: Sulphate	22	0	0	,,
Cyanides: 98% minimum f.o.b. net	0	0	7½	per lb.
Lead: Acetate (Sugar) White, English	27	10	0	per ton.
,, ,, ,, Foreign c.i.f. U.K.	24	5	0	,,
,, ,, Grey	21	15	0	,,
,, ,, Brown at Manchester	17	0	0	,,
Nitrate	24	0	0	,,
Litharge, Flake	15	10	0	,,
,, Powder	16	0	0	,,
Red Lead, Genuine, c.i.f. London less 5%	15	10	0	,,
White ,, ,, Dry ,, ,, ,,	16	15	0	,,
Naphtha (Wood): Miscible, 60 o.p.	0	2	10	per gal.
Solvent	0	2	7	,,
Potash: Bichromate... delivered England...	0	0	3	
Carbonate, 90/92 % ... c.i.f Hull ...	18	10	0	
Caustic, 75/80 % ...... ,, ,, ...	20	15		
Chlorate net	0	0		
Montreal in Store, Liverpool	35	0		
Prussiate, Yellow net	0	0		

	£	s.	d.	
oda: Ash, Caustic, 48 %, Ordinary .. net	5	5	0	per ton.
,, ,, ,, Refined ,,	6	5	0	,,
,, Carbonated, 48 % ,,	5	10	0	,,
,, ,, 58 % (Ammonia Alkali) net	4	10	0	,,
,, Bleachers' Refined Caustic 50/52 % net	6	10	0	,,
Caustic, White, 77 % ,,	10	10	0	,,
,, ,, 70 % ,,	9	12	6	,,
,, ,, 60 % ,,	8	12	6	,,
,, Cream, 60 % ,,	8	10	0	,,
Crystals, in bags	3	0	0	,,
,, barrels	3	7	6	,,
Acetate c.i.f. Hull net	16	15	0	,,
Bicarbonate, in 1 cwt. kegs	6	15	0	,,
Bichromate......delivered England...	0	0	2¼	per lb.
Chlorate net	0	0	3$\frac{1}{16}$	per lb.
Nitrate . ex quay Liverpool, ... ,,	11	7	6	per ton.
Phosphate	9	5	0	,,
Prussiate net	0	0	3⅝	per lb.
Silicate, Solution, 140° Tw.	4	10	0	per ton.
Sulphate (Glauber Salts)	1	12	6	,,
,, (Saltcake, 95%)	1	15	0	,,
ulphur: Recovered	4	15	0	,,
Roll	6	15	0	,,
Flowers	7	10	0	,,
inc: Sulphate	6	15	0	,,

MINERALS.

	£	s.	d.	
arytes: Lump Carbonate, 90/92%	3	10	0	per ton.
Sulphate, No. 1, White	2	15	0	,,
hina Clay: of various qualities for all purposes; prices from about 11/- to about 30/- per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid.				
hrome Ore: Basis 50% c.i.f. British Ports	3	7	6	,,
anganese: Lump c.i.f. Liverpool 10¼d.	per metallic unit.			
chre: French JC f.o.b. Rouen, net	2	5	0	per ton.
,, JF	5	10	0	,,
alc: (French Chalk) c.i.f. Liverpool	3	10	0	,,

OILS, etc.

	£	s.	d.	
niline Oil net	0	0	4¾	per lb.
,, **Salt** ,,	0	0	4½	,,
astor Oil: French, 1st pressure, f.o.b. Marseilles less 1¼%	22	15	0	per ton.
English, 1st pressure, f.o.r. Hull, less 2½%	23	5	0	,,
ocoa Nut Oil: Ceylon, ex store Manchester net	29	10	0	,,
Cochin, ex store Manchester net	32	0	0	,,
otton Seed Oil: Refined at Hull, less 2½% naked	13	15	0	,,
Edible...at Hull, less 2½% naked	14	5	0	,,
lycerine: Crude, 80% net	31	0	0	,,
inseed Oil: Raw... ..at Hull, less 2½% naked	13	17	6	,,
Boiled......at Hull less 2½% naked	14	17	6	,,
tarch: American Pearl...at Manchester, net	8	15	0	,,
Dextrine ,, ,,	17	15	0	,,
Farina ,, ,,	15	0	0	,,
hellac: Standard TN orange spot		147/-		per cwt.
urpentine: American.........at Liverpool	38	0	0	per ton.
Russian ....at Hull...net	19	0	0	,,

TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote :—

COLONIAL WOODS.

Timber.

		£	s.	d.		£	s.	d.
Quebec Square White Pine...	per cub. ft.	0	1	9	to	0	3	0
Quebec Waney Board Pine...	,,	0	2	8		0	3	9
St. John Pine, 18 in. average	,,	0	2	4		0	3	3
Lower Ports Pine	,,	0	1	3		0	1	8
Quebec Red Pine	,,	0	1	6		0	2	0
Quebec Oak, 1st quality	,,	0	2	9		0	3	4
Quebec Oak, 2nd quality ...	,,	0	1	6		0	2	6
Ash	,,	0	1	6		0	2	3
Elm	,,	0	3	3		0	3	10
Hickory	,,	0	2	0		0	2	6
Quebec Birch	,,	0	1	6		0	2	3
St. John Birch	,,	0	1	6		0	2	0
Birch Planks	,,	0	0	9		0	0	11
Spruce Spars	,,	0	0	10		0	1	0

Deals.

		£	s.	d.		£	s.	d.
1st quality Quebec Pine	per std.	22	10	0	to	32	10	0
2nd do. do.	,,	17	0	0		22	0	0
3rd do. do	,,	11	10	0		13	0	0
St. John, N.B., etc., Spruce	,,	6	15	0		7	5	0
Lower Ports Spruce.. ..	,,	6	10	0		6	15	0
Spruce Boards	,,	5	10	0		6	0	0

UNITED STATES, etc., WOODS.

Pitch Pine.

		£	s.	d.		£	s.	d.
Hewn	per cub. ft.	0	1	4	to	0	1	8
Sawn	,,	0	0	11		0	1	6
Planks, Stowage	,,	0	0	10		0	1	0
Boards, Prime	per std.	12	10	0		16	0	0
Oak Timber	per cub. ft.	0	1	6		0	2	6
Oak Planks	,,	0	1	6		0	2	1
East India Teak	per load	12	0	0		16	0	0
Greenheart	,,	6	15	0		7	10	0

EUROPEAN WOODS.

Timber.

		£	s.	d.		£	s.	d.
Riga Redwood	per cub. ft.	0	1	6	to	0	2	0
Dantzic and Memel Fir, Crown	,,	0	2	1		0	2	6
Dantzic and Memel Fir, Middling	,,	0	1	9		0	1	11
Stettin	,,	0	1	9		0	1	11
Swedish	,,	0	1	0		0	1	3
Riga Whitewood	,,	0	1	0		0	1	3
Norway Mining Timber	,,	0	0	9		0	1	0
Dantzic and Stettin, etc., Oak	,,	0	2	6		0	3	0
Norway Spars	,,	0	1	2		0	1	9

Deals.

		£	s.	d.	£	s.	d.
Red Archangel and Onega, 1st quality	per std.	19	0	0	20	0	0
Red Archangel and Onega, 2nd quality	,,	14	0	0	16	0	0
Red Archangel and Onega, 3rd quality	,,	10	10	0	12	10	0
St. Petersburg, 1st quality...	,,	16	0	0	17	10	0
Do. 2nd ,, ...	,,	14	0	0	15	0	0
Gefle	,,	11	10	0	16	0	0
Wyburg	,,	11	0	0	12	10	0
Uleaborg	,,	10	0	0	12	10	0
Gothenburg	,,	11	0	0	16	0	0

SELECTED PATENTS.

Compiled expressly for this journal by **Messrs. Page and Rowlingson, Engineering Patent Agents, 28, New Bridge Street, London, E.C.,** and at Manchester.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton Buildings, Chancery Lane, W.C., at the uniform price of 8d.

NEW PATENTS APPLIED FOR.

When Patents have been communicated the names of the communicators are printed in italics.

4011. J. Haviland, F. H. Haviland, and J. Farmer, Glasgow. Feb. 27th.—Improvements in and relating to appliances for elevating and discharging or conveying grain and the like.

4012. W. G. Tilbrook, Glasgow. Feb. 27th.—Lever fog signal for railways.

4017. R. C. Harse, Dowlais. Feb. 27th.—Improvements in or relating to extensible belts or straps.

4019. E. C. Wade, Lewes. Feb. 27th.—An improvement in wheels.

4024. J. E. King, Leeds. Feb. 27th.—An improved metallic packing

4029. J. Derbyshire and Co., Derbyshire, Stanley. Feb. 27th.—Improvements in pedestals or bearings for colliery corves, tubs, wagons, or the like.

4038. M. Doyle and R. J. O'Neill, London. Feb. 27th.—Improvements in smoke consumers.

4039. M. M. Friedlaender, London. Feb. 27th.—Improvements in engine machinery and the like centrifugal governers.

4053. H. B. Walda, London. Feb. 27th.—Improvements in rotary engines.

4056. H. E. Newton, London. Feb. 27th.—Improvements in internal combustion engines. (*The International Steam Pump Co., U.S.A.*)

4059. J. M. Chambers, London. Feb. 27th.—An improved ventilator.

4068. H. Lentz, London. Feb. 27th.—Valve operating mechanism for steam engines and the like.

4074. The Hoffman Manufacturing Co., Ltd., and W. B. Mair, London. Feb. 27th.—Improvements in thrust bearings for propeller shafts and like rotating parts.

4080. O. Imray, London. Feb. 27th.—Improvements in rotary rock-drilling machines. (*Siemens-Schuckertwerke G. m. b. H. Germany.*)

4087. F. Sellers. F. G. Wallace, and C. Capel, London. Feb 27th.—Improvements in or relating to gas generating plant for internal combustion engines.

4093. F. H. Brenton and J. Struthers, London. Feb. 27th.—Improvements in cribbing or shoring for excavations.

4094. E. Baville, London. Feb. 27th.—Improvements in and relating to tool holders for machine tools. (Date applied for February 27th, 1904.)

4098. J. Johnston, and H. W. Buddicom, London. Feb. 27th.—Improvements in variable speed gear.

4110. F. Wilkinson and C. Collinge, Rochdale. Feb. 28th.—Improved locking arrangement for fish-bolt nuts.

4111. H. B. Horne, Gateshead-on-Tyne. Feb. 28th.—Improvements in apparatus for distributing steam or other actuating fluid in fluid-pressure engines or motors.

4114. J. H. Boylan, Manchester. Feb. 28th.—Improvements in tubes for steam generators, superheaters, feedwater-heaters, and economisers.

4115. J. H. Boylan, Manchester. Feb. 28th.—Improvements in tubes for steam generators, superheaters, feedwater-heaters, and economisers.

4142. C. Walton, London. Feb. 28th.—Improvements in and relating to boring machines for rock, coal, or other material

4151. H. Kochheim, E. Kochheim, and G. Reuter, London. Feb. 28th.—Improvements in and relating to steam boilers.

4175. T. M. Down and A. Marchant, London. Feb. 28th.—Improvements in stocks and dies for cutting screw threads.

4176 S. S. Aburn and F. W. Mason, London. Feb. 28th.—Improvements relating to lock-nuts.

4182. W. B. Hardy, London. Feb. 28th.—Improvements in and relating to the preventation and removal of incrustation and corrosion in steam generators, water-heating pipes, and the like.

4185. A. Brander, London. Feb. 28th.—Improved reversing rotary valves for steam engines.

4188. J. H. K. McCollum, and J. W. L. Forster, London. Feb. 28th.—Improvements in fluid turbine engines.

4193. H. S. Scott and H. F. Tyzack, London. Feb. 28th.—Improvements relating to turbines.

4196. O. Briede, London. Feb. 28th.—Improvements in or relating to the manufacture of rivets, bolts, and the like. (Date applied for, March 1st, 1904.)

4197. B. W. Head, London. Feb. 28th.—Improvements in apparatus for use in charging open hearth furnaces and the like.

4219. G. Quick, Bournemouth. March 1st.—Improvements in screw propellers.

4231. N. S. Arthur and J. S. Binnie, Glasgow. March 1st.—Improvements in and connected with the fire grates of steam boilers and other furnaces.

4235. W. James, Chester. March 1st.—Improvements in or appertaining to appliances for removing and replacing the piston rings of internal combustion engines or the like.

4248. S. E. Alley and D. H. Simpson, Glasgow. March 1st.—Improvements in and relating to steam engines.

4252. G. Dawson and W. A. Dawson, Kingston-upon-Hull. March 1st.—Improvements in drilling and boring heads to be applied to drilling and boring machinery, hand tools, and the like

4277. J Cowan, London. March 1st.—Improvements in and relating to water-tube boilers.

4284. H. T. Wright, London. March 1st.—Improvements in connection with turbines driven by power generated by internal combustion.

4293. C. Casals, London. March 1st.—New or improved fire bar.

4297. W. M. Bowron, London. March 1st.—Method and means for producing (irrespective of the power applied), different speed in one direction from that in the opposite direction of the piston or plunger of reciprocating engines or pumps, or the like.

4300. H. R. Buddenborg, London. March 1st.—Improvements in or relating to pumps, and especially pumps for liquids containing more or less granular material. (*The General Construction Co., U.S.A.*)

4309. F. E. Reed, Kingston-on-Thames. March 2nd.—Improvements in pressure regulators for force pumps.

4358. C. C. Lewis, London. March 2nd.—Improvements in turbines for elastic fluids.

4396. J. P. Lowson, Manchester. March 3rd.—Improvements in steam superheaters.

4398. C. Willetts, jun., and A. H. Rothan, Birmingham. March 3rd.—Improvements in worm and worm wheel pulley blocks, hoists, lifts, and the like.

4400. J. Hamilton, Glasgow. March 3rd.—Improvements in the arrangement of turbine propelling machinery on shipboard.

4407. J. S. D. Shanks and A. W. Metcalfe, Belfast. March 3rd.—Improvements in pressure generators for driving engines and the like.

4411. N. MacNicoll, Rutherglen. March 3rd.—Improvements in steam boilers.

4416. R. Anderton, Halifax. March 3rd.—Improvements in steam superheaters.

4460. H. Sleep and B. Solomon, London. March 3rd.—An improvement connected with taps or cocks.

4461. H. Sleep and B. Solomon, London. March 3rd.—An improvement in taps or cocks.

4465. D. Luigi, London. March 3rd.—Improvements in and connected with water and like taps.

4475. M. M. Dessau, London. March 3rd.—Improvements in and relating to rolling tube packings.

4476. The Warwick Machinery Co., Ltd., London. March 3rd.—Improvements in and relating to elastic fluid turbines. (*The General Electric Co., U.S.A.*)

4491. D. Muckley and A. Payne, Warrington. March 4th.—An improved drum for winding or coiling wire rope—copper, iron, or steel—electric cable, lead tube, hemp, or cotton rope.

4511. W. Rowbotham, Birmingham. March 4th.—Improvements in gas, oil, and like engines.

4516. C. Tuckfield and W. G. de F, Garland, East Molesey. March 4th.—An improved apparatus for propelling ships, vehicles, and other purposes.

4528. The Haste Pump Co., Ltd., and J. M. Hewitt, London. March 4th.—Improvements in pumps.

4540. The Elektrizitats-Actien-Ges., vormals W. Lahmeyer and Co , London. March 4th.—Improved means for alternately driving from a reciprocating engine and a rotary engine. (*Date applied for, March 4th,* 1904.)

4559. The Tangye Tool and Electric Co., Ltd., and C. Pendlebury, London. March 4th.—Improvements in lathes for turning railway carriage and other axles.

4563. S. Turton, London. March 4th.—Improvements in and relating to brickwork for boiler setting, and for similar purposes.

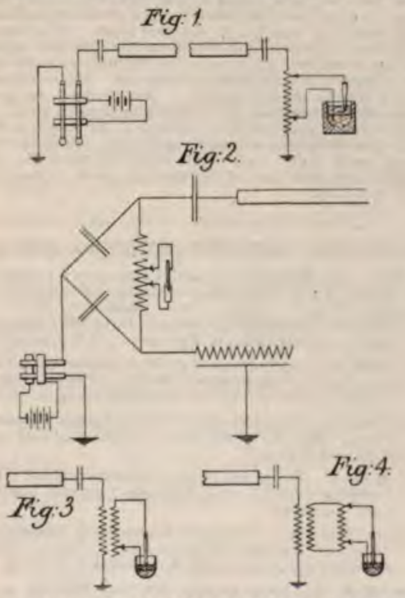
4569. C. H. Read and E. Jones, London. March 4th.—New or improved water bridge or arch for the furnaces of steam generators.

4574. R. H. Rice, London. March 4th.—Improvements in shaft bearings. (Date applied for, March 4th, 1904.)

RECENT SPECIFICATIONS.

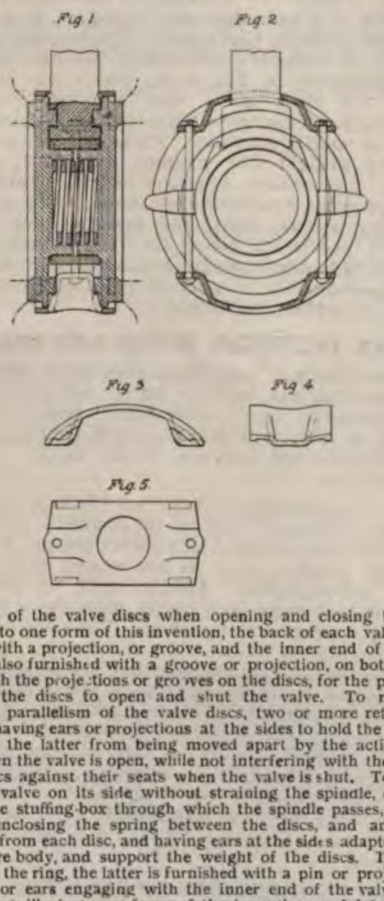
ELECTRICAL RECEIVING APPARATUS.

J. T. Armstrong and A. Orling, of London. Jan. 27th, 1904.—This invention relates to the arrangement of electro-capillary receiving apparatus, and has for its object improvements whereby transient and other currents or disturbances occurring in the line or other circuit, or part thereof, may be obviated or discharged without disturbing or interfering with the proper working of such apparatus. The object of the invention is to overcome the difficulties of stray currents, or other disturbances, for instant constantly varying potential. A shunt is employed through which such disturbances may find relief. According to one arrangement a variable resistance is used which may or may not be inductive, which is connected up in the place of the usual receiving apparatus, so that the cable and the earth, or other equivalent parts, which constitute electro-static capacities, may discharge through it. To this variable resistance the terminals of the electro-capacity apparatus are connected at points of suitable potential difference. Instead of this arrangement an induction coil or transformer may be employed, the primary of which takes the place of the variable resistance referred to in the arrangement first described, while the receiving apparatus is connected to the terminals of the secondary coil, which may also be provided with a suitable shunt.



STOP VALVES.

J. Hopkinson and Co., Ltd., J. Hopkinson, and R. Kilburn, of Huddersfield. April 2nd, 1904.—Relates to parallel slide stop valves of the kind in which the valve discs are pressed against their faces by a spring, and this invention has for its chief object the provision of improved means for maintaining the substantial parallelism of the valve discs when opening and closing the valve. According to one form of this invention, the back of each valve disc is provided with a projection, or groove, and the inner end of the valve spindle is also furnished with a groove or projection, on both sides, to engage with the projections or grooves on the discs, for the purpose of operating the discs to open and shut the valve. To retain the substantial parallelism of the valve discs, two or more retainers are provided, having ears or projections at the sides to hold the discs, and to prevent the latter from being moved apart by the action of the spring when the valve is open, while not interfering with the pressing of the discs against their seats when the valve is shut. To allow of fixing the valve on its side without straining the spindle, or unduly wearing the stuffing-box through which the spindle passes, a ring is provided enclosing the spring between the discs, and an annular projection from each disc, and having ears at the sides adapted to rest on the valve body, and support the weight of the discs. To prevent rotation of the ring, the latter is furnished with a pin or projection, or with lugs or ears engaging with the inner end of the valve spindle. The drawings illustrate one form of the invention, and detailed views of the retainer for preventing undue spreading of the valve discs.



AUTOMATIC REGULATING APPARATUS FOR BOILER AND THE LIKE.

H. B. Kershaw, of Stalybridge. March 26th, 1904.—This invention is designed to provide an improved automatic regulating apparatus for controlling the dampers of steam and hot-water boilers, for regulating the steam or other supply to heaters, coolers, calorifiers, radiators, and the like, for governing pumps, pumping hot water, and for similar purposes. A hollow bulb is placed in the boiler pipe, tank, or the like, the temperature in which it is desired to maintain constant, or with regard to which it is desired to govern the damper, valve, or the like. This bulb is connected with a suitable piston or ram, preferably placed externally to the pipe, tank, or like, which is pivoted to a lever suitably fulcrummed, so that the movement of the lever by the piston or ram will give an increased movement at the other end of the lever, which is connected with the damper, valve, or like, which it is desired to regulate in any convenient way. A spring or weight is provided to return the lever and ram to normal position. To actuate the ram any suitable liquid expansible on an increase in temperature is placed in the bulb, a suitable filling hole with plug being provided for the purpose, preferably externally of the pipe, tank, etc., which, on any increase in the temperature round the bulb, increases in volume and presses against the piston or ram, causing it to move outwards and actuate the lever or other device, which regulates the damper valve or other governor as desired.

NEW PUBLICATIONS.

"MECHANISM."

By S. Dunkerley, M.Sc., A.M.Inst.C.E., M.I.Mech.E. Longmans, Green and Co. 9s. net.

Professor Dunkerley's elementary treatise on the kinematics of machines is the outcome of his many years' experience acquired in lecturing on the subject at the Universities of Cambridge and Liverpool, and at the Royal Naval College, Greenwich. The writer's intimate knowledge of students' requirements fits him admirably for the authorship of this work, which was specially designed for their use. The introductory section describes in detail various machine tools and mechanism required for special purposes. Then follows a complete account of straight line motions, couplings, velocity diagrams, approximate solutions to link motions and radial valve gears, acceleration diagrams, toothed wheels, non-circular wheels, cams, and machines for cutting teeth. The book is well got up, the illustrations excellent, and the student who makes a careful study of this work will be assured of a solid grounding in the fundamental principles of applied mechanics.

"GERMAN TECHNICAL WORDS AND PHRASES.'

An English-German and German-English Dictionary of technical and business terms and phrases, used in commerce, arts, sciences, professions and trades. By C. A. Thimm, F.R.G.S., and W. von Knoblauch. E. Marlborough and Co. Cloth, 2s. 6d. Leather, 3s. 6d.

This is a companion volume to "French Technical Words and Phrases," and is an excellent attempt to collect, within the compass of a pocket volume, technical terms and phrases such as are passed over by the ordinary lexicographer. Roman type is employed throughout, and there is a useful appendix with tables of money, weights and measures. We understand that a similar volume of Italian technical terms is in preparation and have little doubt but that the series will be readily taken up by business men. Of course, in a miscellaneous collection of technical terms, it would be easy to point out omissions, but the publishers welcome suggestions and the utility of future editions should be greatly enhanced by the co-operation of readers and users. In the meantime we think that every business man who is in touch with Germany, will find it worth while to possess a copy of "German Technical Words and Phrases."

"SELL'S DIRECTORY OF REGISTERED TELEGRAPHIC ADDRESSES,

And National List of Large Commercial Houses, and Buyers' Guide, 1905." Price (including three supplements issued quarterly), 21s. Henry Sell, 166, Fleet Street, London, E.C.

To manufacturers and traders of every description this compilation, holding as it does a unique position among the many "annuals," is quite indispensable. With the present issue, the work which has been carefully revised, reaches its twentieth year of publication. Firms interested in exporting industries will find the new feature—an authentic list of British Consuls abroad—of great assistance.

We have also received "Estimating for Builders' Work" and "Measuring Builders' Work." Mechanic's Manuals, edited by Paul N. Hasluck. (Cassell and Co. 6d. net.) The two latest additions to this well-known series contain in a convenient form, a comprehensive digest of the data of these subjects scattered over eighteen volumes of the "Building World."

BOOKS RECEIVED.

"The Home Mechanic." By John Wright. John Murray. 6s. net.

"Ordinary Foundations, including the Coffer-dam Process for Piers. By Charles Evan Fowler. Chapman and Hall.

"Science and Hypothesis." By H. Poincaré. Walter Scott Publishing Company, Ltd. 3s. 6d.

NEW CATALOGUES.

The Mitcham Motor Company, of Cowes, Isle of Wight have issued a catalogue of marine motors and launches, with numerous illustrations and line drawings.

Messrs. Burnham, Williams and Co., Philadelphia, Pa., U.S.A. Booklet No. 48 is a record of recent construction by the Baldwin Locomotive Works. The locomotives illustrated show to full advantage on a slightly tinted ground with a red border line, while the general dimensions are given on the opposite pages in English and French.

Blue Asbestos, as mined in Cape Colony by the Cape Asbestos Company, Ltd., is the subject of a handsome publication issued by this firm. It is claimed that the Cape Blue Asbestos is the most efficient material extant for coverings on account of the natural high non-conducting qualities it possesses, and also because it remains unaffected by atmospheric influences, is neutral, resilient, strong, and light in weight Many interesting blocks illustrate the application of these coverings to boilers and pipes, etc. Attention is also drawn to asbestos packings, cloth, curtains, rope and cord, thread and yarns, paper, felt, etc., and lists and illustrations are included of vessels of many nations which have been supplied with this material by the company.

Messrs. W. and T. Avery, Ltd., of Soho Foundry, Birmingham, forward Sheet No 89, drawing attention to their patent weighbridges, specially designed for public use to print the weights on tickets and also to count the number of loads weighed: Sheet No. 250 illustrates the firm's special "Motor-Wagon" weighbridge, for weighing motor-wagons and trailers.

An illustrated price list of Albion cars has been issued by the Albion Motor-Car Company, Ltd., of South Street, Scotstoun, Glasgow. Excellent half-tone illustrations are included, as well as some press notices and testimonials from owners of Albion cars.

The Preliminary List, 1905, of the "Duryea" Power Carriages, which we note are British built throughout, has been issued by the Duryea Company, Ltd., of Duryea Works, Widdrington-road, Coventry.

The General Electric Company, Ltd., 71, Queen Victoria Street, E.C. A finely printed catalogue with a striking blue and gilt cover has just been issued by this company, dealing with their "Witton" continuous current motors, open protected, semi-enclosed, enclosed ventilated, and totally enclosed types. It is interesting to note that the motors in question have been entirely remodelled. The design of the bearings is such that the motors can be fixed on a horizontal base, a vertical wall, or overhead. All parts are made to gauge and strictly interchangeable. Measurements are given both in inches and centimetres, and weights in lbs. and kilos. There is also some very instructive information as to the approximate power required to drive various classes of machinery. Altogether it will be seen that great pains have been taken to make the catalogue thoroughly up-to-date and of the greatest utility to manufacturers in search of motors.

MEETINGS FOR THE ENSUING WEEK.

FRIDAY, MAR. 17.—National Physical Laboratory: Presentation of Report, 3 p.m.—Institution of Mechanical Engineers, Storey's Gate, 8 p.m.: Paper, "First Report to Steam Engine Research Committee," Professor David S. Capper.—North-East Coast Institution of Engineers and Shipbuilders.

SATURDAY, MAR. 18.—Agricultural Hall Motor Show opens.—Glasgow Technical College Scientific Society: Paper, "Independent Condensing Plant," Mr. Charles Day, 7.30 p.m.

MONDAY, MAR. 20.—Society of Arts: Second Cantor Lecture, "Telephony," Mr. H. Laws Webb, 8 p.m.—Institute of Marine Engineers, 8 p.m.

TUESDAY, MAR. 21.—Royal Institution, Albemarle Street: Professor Dalby on "Engineering Problems," 5 p.m.—Institution of Civil Engineers.

WEDNESDAY, MAR. 22.—Liverpool Engineering Society: Paper "Electric Traction on Main Line Railways."—Geological Society, 8 p.m.—Society of Arts, Ordinary Meeting.

THURSDAY, MAR. 23.—Royal Society, Ordinary Meeting, 4.30 p.m.—Institution of Electrical Engineers, Great George Street: Discussion on Papers read at the previous meeting.

FRIDAY, MAR. 24. — Physical Society, 5 p.m.—Electro-Harmonic Smoker.—Royal Institution: Sir Oliver Lodge, "A Pertinaceous Current," 9 p.m.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

VOL. VI. LONDON, FRIDAY, MARCH 24, 1905. No. 28.

The Offices of "Page's Weekly," Wednesday Evening.

THE deluge of rain which fell last Friday must have interfered considerably with the attendance of invited guests at the National Physical Laboratory, a circumstance all the more regrettable when it is remembered that an institution of this kind can only on rare occasions throw open wide its doors and welcome interruptions. The drive of Bushy House was about as soddened as it could possibly be and in the entrance hall Lord Rayleigh (President of the General Board), and Lord Kelvin received the guests in an atmosphere of mackintoshes and umbrellas. Thereafter it was a case of "go as you please." The visitors had full liberty to wander along the corridors and view the work in process in the different departments entirely at their own discretion. That veteran of science, Lord Kelvin, was encountered in several of the rooms taking the keenest interest in the work of the laboratory and showing a decided disposition to forget all about the inspection and start experimenting once more on his own account.

There is so much to see at Teddington and there are so many fascinating things of divergent interest, that we almost despair of being able, within the limits of our space, to afford an adequate view of the work which is in progress. Devoting ourselves to special points of interest however, it may be noted that in Room 20 (thermometry), Dr. Harker showed in operation, furnaces of a new type for the attainment, electrically, of temperatures between 800 deg. C. and 2,200 deg. C., while in room 55 was shown a new resistance box and installation for platinum thermometry, with tank for highest grade thermometer comparisons. The engineering department, under Dr. Stanton and Mr. Jakeman, is in a

Photo. by Elliott & Fry.

DR. R. T. GLAZEBROOK, F.R.S.,
Director of the National Physical Laboratory.

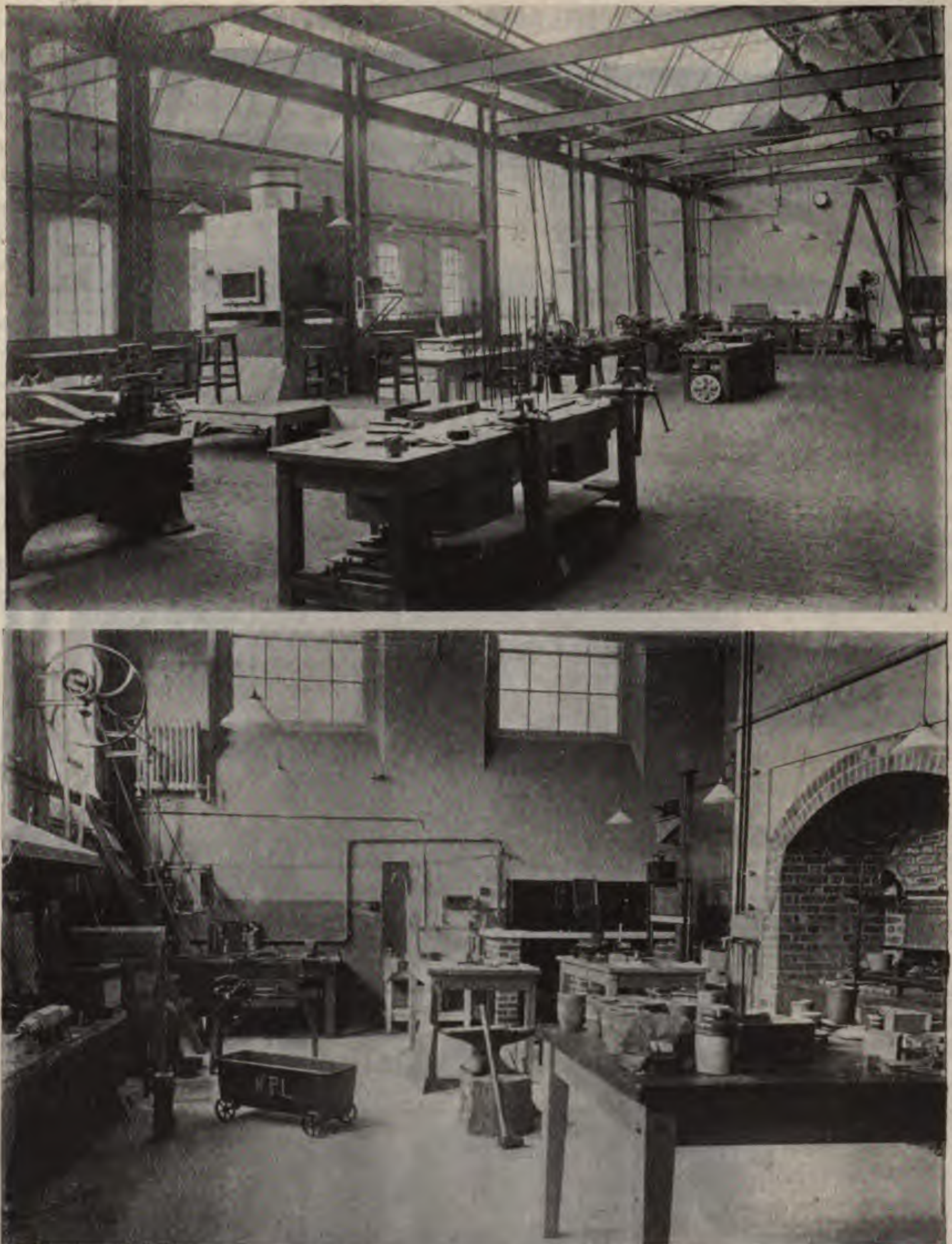
separate building. Here we saw a quantity of apparatus which has already been freely described and also several additions, perhaps the most interesting of the latter being a 1-ton testing machine for alternate tension and compression which has just been acquired, and a photomicrographic outfit for metals.

A conspicuous object is the apparatus for the measurement of the pressure on surfaces in a uniform current of air, and we understand that the experiments carried on in the laboratory are now being applied to the measurements of wind pressure which are being undertaken out of doors at the tower. The Whitworth standard screw cutting lathe in another building also attracted a good deal of attention. In the Electro-technical Department, under Mr Paterson and Mr. Rayner, the latter explained the investigations of temperature rise in transformers, by means of thermo junction wires, and excited our wonder at the extreme sensitiveness of the delicate portable voltmeter by which the temperature readings are made. In the chemical laboratory, under Dr. Caspari and Mr. Naylor, a metallurgical analysis was watched attentively, and elsewhere Mr. Campbell and Mr. Melsom (electricity), Mr. Smith (electrical standards), Mr. Paterson (photometry), Dr. Carpenter and Mr. Longmuir (metallography), Mr. Jeffcott and Mr. Attwell (metrology), Mr. Selby and Mr. Hugo (optics), Mr. Selby and Mr. Brookes (tidal prediction) ably seconded the efforts of the director, Dr. R. T. Glazebrook, F.R.S., in making the visit profitable and instructive.

Both as regards the work done and the state of its finances, the laboratory can look back upon a very satisfactory year. In physics department the work included, *inter alia*, a comparison of the mercury standard of resistance constructed in the previous year, the investigation of certain anomalies in standard cells, of both the Clark and cadmium patterns, the construction of the electrical portions of the ampere balance for the British Association, and numerous tests of the dielectric resistance of different varieties of gutta-percha. Progress was made in equipping an electro-technical department to undertake the testing of electrical apparatus on a commercial scale, and electrical research work was carried out on behalf of the Engineering Standards Committee to determine the maximum temperatures permissible in electrical machinery. (See Page's Weekly, page 571.)

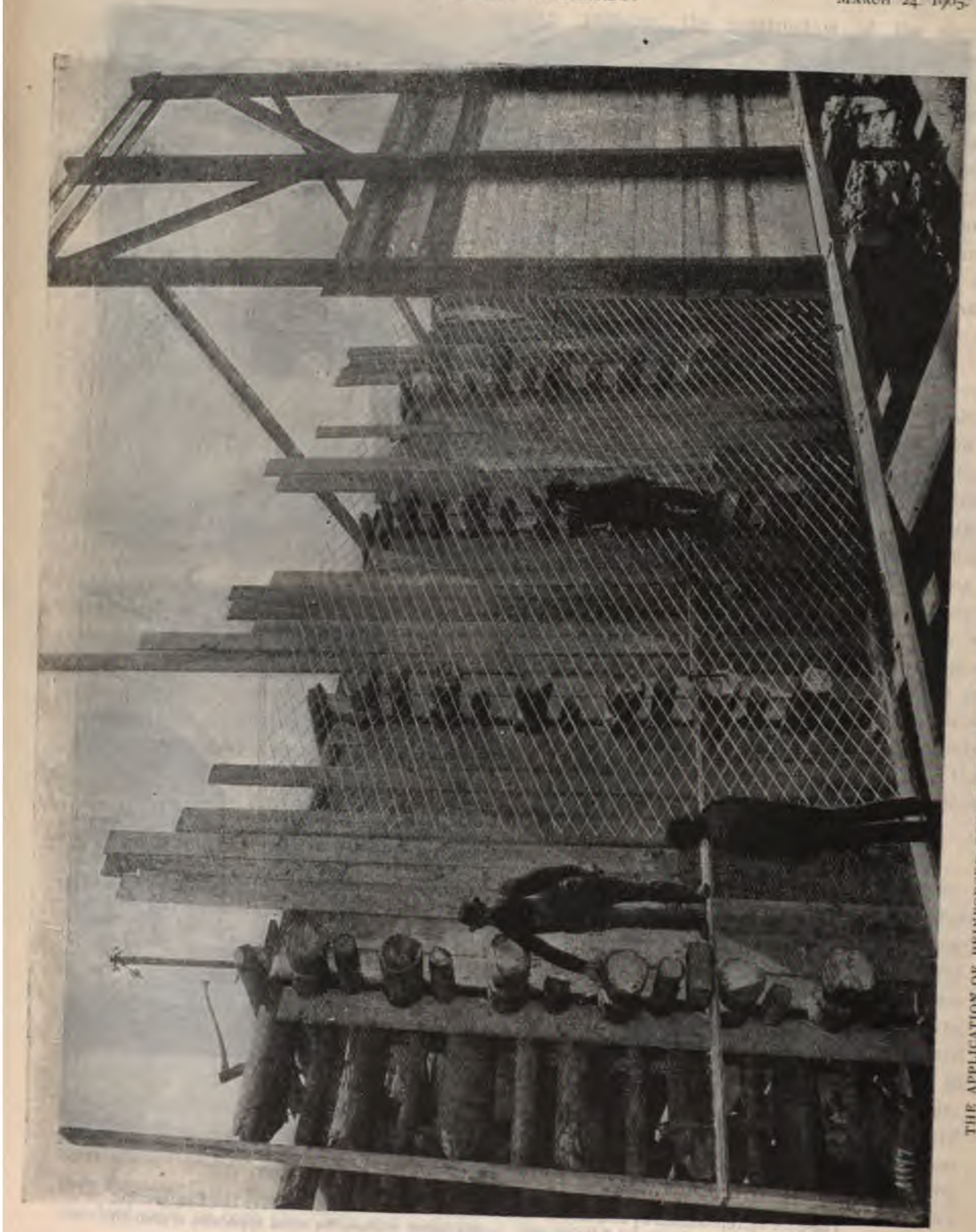
In the thermometric department a considerable amount of new apparatus was installed, and the work included the final stages of a research on the specific heat of iron at high temperatures and the beginning of a study of the resistance and thermo-electric properties of solid electrolytic conductors such as are used in Nernst lamps, with the view of designing a system of electrical high-temperature measurements based on some of the properties of zirconia, yttria, etc. In the metallurgical department extensive tests were carried out on a series of nickel, carbon, and manganese iron alloys, prepared by Mr. Hadfield at the Hecla Works, Sheffield, and also an inquiry into the critical ranges on heating and cooling of modern high-speed tools.

In the photometrical department inter-comparisons were made by means of glow lamps with the National Standards Bureau, Washington, and the Electrical Testing Laboratories, New York, as well as with the Berlin Reichsanstalt, and further investigations are now being undertaken to determine the ratios between the standards of candle-power accepted in America, Germany, France, and Great Britain. In the engineering department the standard leading screw lathe referred to above was fitted with a compensation bar to correct its errors and is now true to within 0·0001 in. over the length of 36 in.; it has been used to cut



INTERIOR VIEWS AT THE NATIONAL PHYSICAL LABORATORY.

These views, reproduced by courtesy of The World's Work and Play, show (1) The Engineering Laboratory, (2) The Metallurgical Laboratory. In the upper picture the wind apparatus is seen on the left.



THE APPLICATION OF REINFORCED CONCRETE IN DRY DOCK CONSTRUCTION AT HUNTER'S POINT, CAL. *(See page 626.)*

a screw for Armstrong, Whitworth and Co., the errors in pitch of which, measured from one end, lie between 0·0003 and 0·0002 in. in a length of 36 in. The effects of wind pressures on structures and the resistance of materials under alternating stresses have also been under investigation. Much of this work is being continued during the present year, and among new researches proposed may be mentioned the influence of impurities on copper, the relation of carbon to iron in cast iron, and the so-called constituents of quenched steels. In addition to these and other researches which have been successfully carried through, a number of inquiries have been declined for want of sufficient equipment. The Committee hope that this may, however, be shortly remedied. During the year some 28,000 instruments of various kinds were tested. Of these, more than half were clinical thermometers.

At the beginning of the year the financial position was a source of anxiety, but large additions to the donation fund and increase of work in the latter part of the year turned the loss that was feared into a credit balance, the expenditure being £12,257 3s. 7d. and the receipts £12,753 3s. 9d. But this result, satisfactory though it is, was due in great measure to efforts made to increase the donation list, and the committee recognise that such a source of income is necessarily precarious. The Treasury has agreed to increase the annual grant for 1905–1906 from £4,000 to £5,500, and will in addition be willing to consider the increase of this sum in 1906–1907 to £6,000. In regard to the memorandum of the committee pointing out the need for capital expenditure on new buildings and equipment to an amount approaching £30,000, the Treasury replied that with every desire in the public interest to develop the resources of the laboratory, it felt that in view of the financial exigencies of the time and the numerous demands on the exchequer, this somewhat extensive programme could only be carried out by being spread over a number of years; but it was prepared to ask Parliament for an additional grant of £5,000 for 1905–1906, and hoped that for four or five years to come it might be possible to provide an equal sum.

As to the gradual improvement in the management of the Transvaal mines, Mr. H. Ross Skinner, whom we quoted last week, is of opinion that this should further increase as years go on owing to the larger number of young men who will be available, and who have made mining their profession and practically their life's study. He advises them to always remember that book knowledge alone will not make a manager, but has to be combined with the great gift of common-sense, and the ability to handle men. The Government examination will also gradually tend towards raising the standard, but the giving of a Government certificate should be counted as the foot and not the top of the ladder. It is only by reading, observing, and thinking that a manager can keep pace with the times and be able to cope with the problems incidental to the running of a mine.

In the abstract of Lord Brassey's paper on "Shipbuilding for the Navy," issued by the Institution of Civil Engineers, we note :—

"The author concluded by urging the desirability of discussion on such questions, which were of exceeding complexity and momentous import to the nation. It had been decided that the proceedings of the Admiralty Advisory Committee on Shipbuilding should not be made public. Such discussions as those which might from time to time be held under the auspices of the Institution of Civil Engineers were the more valuable for the guidance of public opinion."

It is difficult to see how public opinion is to be guided by discussions from which pressmen are rigorously excluded.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

DAVIDGE PAGE, Editor.

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Telephone No: 3349 GERRARD.
Telegraphic and Cable Address: "SINEWY, LONDON."

Editorial.—*All communications intended for publication should be written on one side of the paper only, and addressed to " The Editor."*

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Foreign and Colonial Subscribers receiving incomplete copies through newsagents, are requested to communicate the fact to the Publisher, together with the agent's name and address.

New Copy for Advertisements,

Alterations, &c., intended for insertion in the current week's issue must be delivered **not later than 4 p.m. on Monday.** If proofs are required the copy and blocks should reach us several days earlier.

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NEWS ITEMS.

The *Victorian*, the newly-built Allan Line steamer, is the first turbine engined boat to cross the Atlantic.

A new Japanese battleship, the largest warship yet built on the Tyne, was launched at Elswick on Wednesday.

The persistent rumour of a projected amalgamation between the British Westinghouse Company and Armstrong, Whitworth and Co., Ltd., is officially denied.

The Permanent Committee of the International Congress of Technical Education have accepted an invitation for the holding of the next meeting at Milan in 1906.

At the annual meeting of Messrs. William Beardmore and Co., last week, Mr. Albert Vickers said he was happy to report that the new shipyard at Dalmuir was now practically completed.

Early on Tuesday morning a successful trial trip was run with an electrical train over the portion of the Metropolitan Railway on the Inner Circle from Baker Street to South Kensington and back, and from Baker Street to Aldgate and back.

We are pleased to receive confirmation of the following paragraph, which recently appeared in the daily Press: On Saturday, February 25th, the Manchester engineering firm of Messrs. Isaac Storey and Co. received an order by wire for an auxiliary condenser of 900 square feet required by a large shipbuilding company. The condition was attached that delivery must be made by Monday, March 13th. The firm had no finished parts of any description in stock for this work, and had to make the whole condenser from raw material, but they managed to deliver the condenser on Friday, March 10th, two days earlier than required.

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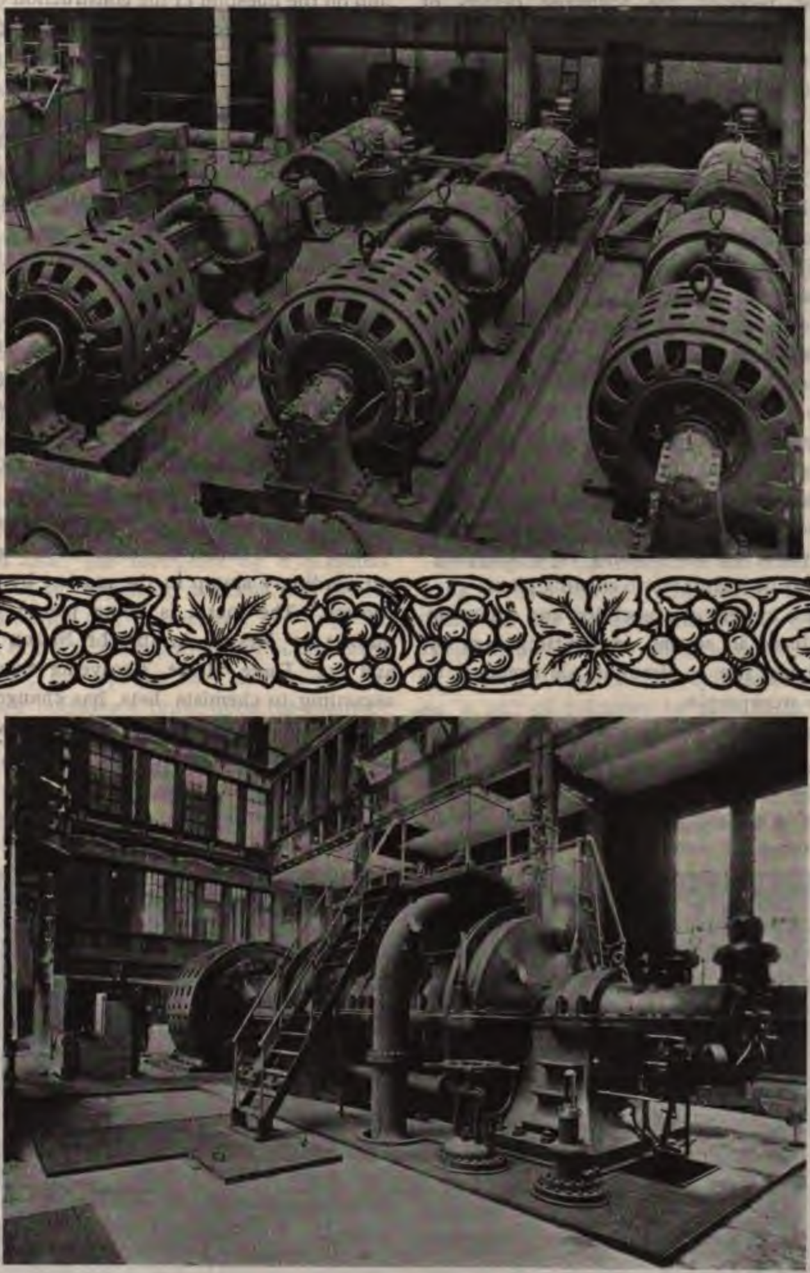


RECENT TURBINE INSTALLATIONS—VI.

(1) Three 1,250 k.w. Westinghouse-Parsons steam turbine generating units in 59th Street Power House of Interborough Rapid Transit Company, New York. (2) 7,500 h.p. Westinghouse-Parsons steam turbine generating units in 74th Street Power House of the Company.

Prizes Offered for Machinery.

We have just received the following details of prizes which are to be awarded by the Association of Italian Manufacturers for the prevention of accidents in factories, in connection with an international competition to be held during the Milan Exhibition next year:—

A gold medal and 8,000 lire for a new appliance for preventing accidents arising from contacts between primary and secondary windings in alternate current transformers. The appliance must fulfil the condition that no disturbance in the action of the transformer must arise in case of atmospheric discharges or abnormal increase of potential.

Gold medal and 1,000 lire for a novel system of hand crane or winch fitted with a simple and practical contrivance to prevent the possibility of the handles revolving during the descent of the load.

Gold medal and 500 lire for a safety appliance, to be simple, strong and reliable, to stop trucks automatically on an inclined plane on the hauling rope snapping. The appliance must be adaptable to existing plant.

Gold medal for a sytsem of absorbtion and collection of the dust produced in sorting and cutting rags by hand without giving rise to draughts detrimental to the health of the workpeople.

Gold medal for a system to carry off by suction the dust generated by carding flax, hemp, and jute, without detriment to the neighbourhood.

Gold medal for a system to prevent the diffusion of dust in lime and cement works.

Overhead Mains.

Reference was made during the recent discussion on "Overhead Mains," at the Institution of Electrical Engineers to the troubles likely to arise in connection with overhead wires which are carried along main roads. An interesting point in this connection arose at the conference of municipal tramway authorities which has just been held in London. It was in relation to the protection of overhead trolley wires At the present time when the Postmaster-General or the National Telephone Company desires to place an electric wire over those of a tramway, it becomes the duty of the tramway authority whether a company or a municipality, to protect the live wire so that the telegraphs or telephone wire may not come in contact with it. This is throwing an unfair burden on the electric tramway interests, more particularly if the overhead equipment of the tramway should have been in position first. In such a case it might be fairly argued that the Post Office or the National Telephone Company should be charged with the duty of affording the necessary protection, and it was decided to ask the Board of Trade to receive a deputation on this matter and on the question of the construction of cars and other matters in connection with the working and equipment of tramways.

Metallic Calcium.

Electrometallurgy has at last succeeded in producing metallic calcium in commercial quantities, and at what must be considered a relatively low price. Until within a few weeks ago this metal had only been available in very small amounts, and remained a rare laboratory specimen; it is now obtainable at a price per kilogramme less than that charged by most chemical dealers for a small one gramme sample. Humphry Davy first formed the amalgam by electrolysing lime, mixed with mercuric oxide and slightly moistened, with a mercury kathode; he isolated the metal in small quantities by distilling off the mercury. Since then many chemists have tried in vain to find a method suitable for its preparation on a larger scale.

Now two German chemists have brought about an extraordinary slump in the market by a new patented process. The metal is being placed on the English market by Messrs. Armbrecht Nelson and Co., of 71 and 73, Duke Street, Grosvenor Square. Its price according to chemists lists, has changed as follows:—

1903	£56 5s. 0d. per oz.
1904	25 0s. 0d. per oz.
1905 (Jan.)	9 0s. 0d. per oz.
1905 (March)	0 1s. 6d. per oz.

From being a mere laboratory curiosity it has become cheap enough to experiment with extensively in connection with the manufacture of armourplate.

The Egyptian State Railways.

Lord Farrer's Commission on the Egyptian State railways recommend the construction of new lines entailing a total expenditure of £700,000. The gap between Assouan and Wady Halfa, 200 miles, it is considered, must sooner or later be bridged, and the Commission think it would pay better to link up the systems by spending £1,000,000 (E) than by spending £600,000 on widening the existing Luxor-Assouan line, and the project of uniting the two systems—the Egyptian of 1,667 miles and the Sudanese of 700 miles—is most worthy of immediate attention, as being quite likely to give a return on capital in a comparatively short time. The Commission find that the administration of the port of Alexandria should be separated from that of the railways. The capital expenditure necessary to improve the existing system and provide the necessary rolling stock is altogether £2,923,750 (E).

MOTOR NOTES.

John I. Thornycroft and Co.

A new Thornycroft vehicle is shown in fig. 1, a special 20-h.p chassis having been fitted with British Vacuum Cleaner Company's plant. The great advantage of the vehicle is that it is self-contained, and the petrol engine can be used to drive the cleaning part alternately with driving the car. There are undoubtedly great possibilities in a combination of this description.

The vehicle is to carry five persons and the cleaner plant up a gradient of 1 in 10. The average working speed on the level is fifteen miles per hour. The engine is of the four-cylinder "Otto" cycle type, with cylinders 4 in. diameter and 4⅜ in. stroke. The cylinders are cooled by water circulation, operated by a pump of the rotary gear type. The ignition fitted is high tension electric accumulator or dry cell. The steering is easily effected from the foot-plate by a diagonal shaft and hand-wheel, operating a worm and worm wheel, and is powerful and irreversible.

The wheels are of the artillery pattern, 34 in. diameter with metal naves, oak spokes, and ash felloes. A pedal on foot-plate operates a brake upon the countershaft, close to the gear box equally effective in either direction, and sufficiently strong to hold the vehicle on the steepest hills. The frame is of strong channel steel, with suitable stiffeners and gussets.

Napier Marine Engine.

The recent sensational trials of *Napier II*, when with a hull specially constructed by Messrs. Yarrow and Co. a speed of thirty miles per hour was obtained with a boat 40 ft. long, has naturally directed attention to the Napier marine engine, and the attempt which is being made to apply the internal combustion engine to marine work is being closely watched by engineers. The opinion has been expressed that to enable such an engine to be built in the large sizes necessary for marine work will mean the development of some form of producer gas engine, but, be that as it may, and while giving every credit to the ingenious design of the hull of the Napier-Yarrow boat, to which the high speed attained is in no small measure due, full recognition must be accorded to the part played by the Napier engine.

The engine is constructed of cast-iron, the engine body being in two halves joined along the centre of the shaft and the cylinders themselves consist of liners forced into the body, which is bored to receive them, by haudralic means. The cylinder heads are one casting, a pair of cylinders for each head, and are bolted through on to the engine body. The crank-shaft is of forged steel, and the bearings are bronze, and very great care is taken in letting together the main bearings and the big ends. The cam-shaft is cut from a solid

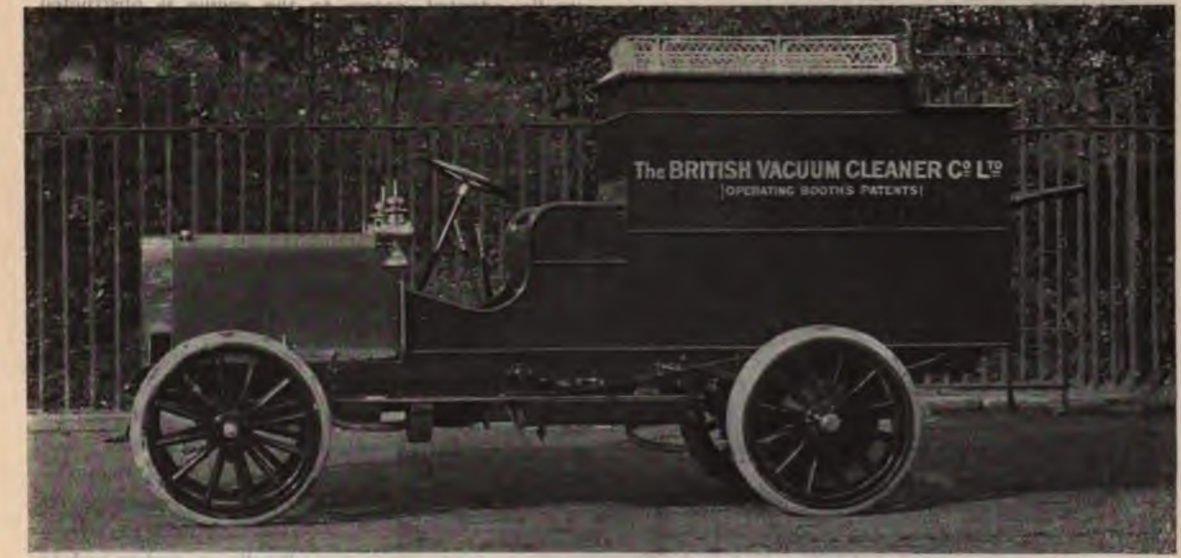

The BRITISH VACUUM CLEANER Cº Lᵀᴰ
(OPERATING BOOTH'S PATENTS)

FIG. 1. 20-H.P. THORNYCROFT CHASSIS, WITH VACUUM CLEANER PLANT.

bar, and is case-hardened and ground to its final dimensions. This system of grinding is the most suitable method for this class of work, as not only can hardened steel parts be used, but the very finest degree of accuracy may be obtained. A great feature of this engine is its flexibility. It is capable of being throttled down to 150 or 200 revolutions, and then accelerated to 1,200, and in all speeds the engine is said to run silently and with practically no vibration.

Special System of Ignition.

The carburetter has been designed to work properly under the usual conditions met with at sea, and it works perfectly in an open boat, no matter the condition of the weather. The throttle is designed so that it automatically keeps the value of the mixture constant, and does not slow the engine down by simply destroying the value of the mixture. The whole system of ignition has been devised to work satisfactorily in damp and wet, and to withstand the corrosive action of sea water.

The system of lubrication is the same as that in use in high-speed electric lighting engines—direct forced lubrication, which is automatic. The Napier reverse gear is noticeable by its great contrast to any other attempt that has been made by engineers to obtain a reversal motion of propeller shaft, driven by an internal cumbustion engine. In many cases we see a large cumbersome device, in which gears and mechanism usually become corroded and fixed unless the gear receives a considerable amount of attention. In the case of the Napier gear, everything is covered and free from the effects of salt water, all the gear and mechanism being enclosed in an oil-tight box, and running submerged in oil.

In this gear there are three positions—ahead, intermediate, and astern. When the lever is placed in the ahead position the gear is firmly and absolutely locked for the ahead movement, and is practically nothing more than a rigid shaft carried in two roller bearings, and provided with a ball-thrust bearing. There is no other gear or mechanism moving, and as this spindle is working submerged in oil no attention is required to thrust or steady bearings. If the lever is placed in the intermediate position, this shaft is broken or disconnected, end from end, but still runs on a very long, substantial spigot bearing, so that the engine shaft can rotate, and the propeller shaft remain free with a minimum of friction and no chance of wear. In the astern position the shaft still remains broken but there is interposed a countershaft, with an interposed gear wheel, which gives an astern or opposite motion to the propeller shaft, and reduces the speed of same.

These three positions are positive, and in connection with this reverse gear is a metal to metal clutch, also running in oil, which, in the Napier practice, forms part and parcel of the flywheel.

The Lanchester Engine.

The Lanchester cars have deservedly won a high reputation for good design and workmanship, and in the new model are one or two new features which are worthy of notice. The most notable departure from their former practice is in the engine. This is of the generally accepted multi-cylindered vertical type. It is placed in the front of the car dividing the foot-board, this position being a distinct advance in accessibility, as, when the bonnet is removed, the engine presents a clean "broad side," whereas if placed in the position usually adopted, access to the engine is obstructed by the wheels and mudguards. The crank-chamber forms an oil well from which the whole of the engine is lubricated automatically under high pressure by means of a pump.

Either magneto or high-tension, with accumulators and trembler coils can be fitted. The water circulation is automatic or thermosyphonic.

The special radiator is constructed from a number of flat cellular plates in which the cells run vertically; it is exceedingly efficient and is simpler and neater in appearance than any radiator previously designed. It is also very easy to clean, having no small cells or crevices such as honeycomb and tubular radiators

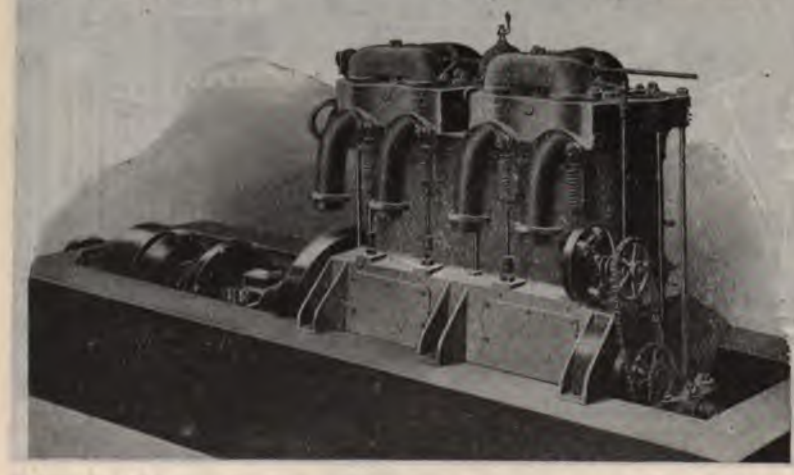


FIG. 2. THE NAPIER 66-M.P. MARINE ENGINE.

with gills have, in which mud will collect, and is sometimes very difficult to dislodge. The clutch is a multi-disc metal to metal one, of the most up-to-date type, and enables the driver to start the car smoothly and silently on the top gear without the slightest shock to the passengers.

The change-speed gears are similar in principle to those previously fitted to Lanchester cars; the gears and the clutch and the main brake being enclosed in an oil-tight gear box, are immersed in oil.

The arrangement for connecting the car frame to the under frames is of somewhat novel construction. The ordinary type of carriage spring is departed from, and, instead of this a single spring is used at each of the four suspension points, acting on the cantilever principle.

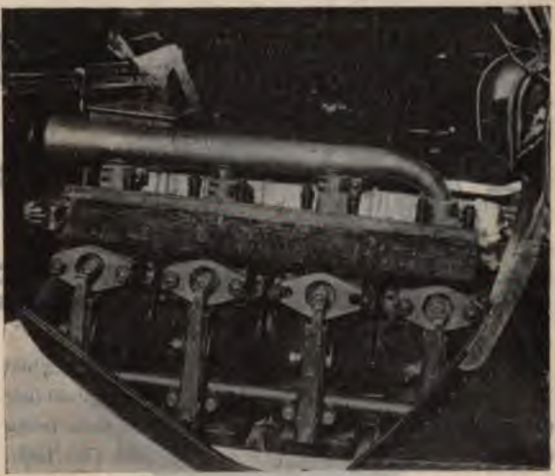


FIG. 3. LANCHESTER MOTOR. SHOWING SIDE ELEVATION.

Garrett 4-5-Ton Motor Lorry.

The exhibit of Messrs. Richard Garrett and Sons has attracted a good deal of attention at the Agricultural Hall, and fig. 4 shows the features of one of their compound steam motor lorries.

The main frame consists of two steel channels of heavy section running the whole length of lorry; they are stayed by cross steel channels of heavy section, bolted on top, and at the back end by two diagonal steel plate stays riveted one on the top, and one on the bottom of steel channels, with proper provision for the trailing pin; at the front end the channels are stayed by a single cross plate bolted to the top. To the two longitudinal steel channels are bolted the pressed steel housings for the springs.

The engine gear box is suspended at three points from the main frame, viz., at the back end by two cast-steel brackets bolted to the two longitudinal steel channels, one on each side, and at the cylinder end by one suspension bolt in the centre, attached at the top to the two cross channels, and at the bottom to the engine gear box by nuts and indiarubber washers, to permit freedom of action and nullify vibration.

The cylinders are compound high and low pressure, mounted horizontally, side by side, and constructed with outside valve chests, rendering the slides easily accessible. The high-pressure cylinder is fitted with piston valve, the low-pressure cylinder with slide valve. The cylinders are lagged with special non-conducting material and sheet steel and provided with drain cocks, double sight-feed lubricator for high and low-pressure cylinders. The engine is noteworthy for its simplicity as a compound engine for this purpose, numerous usual moving parts and joints being dispensed with.

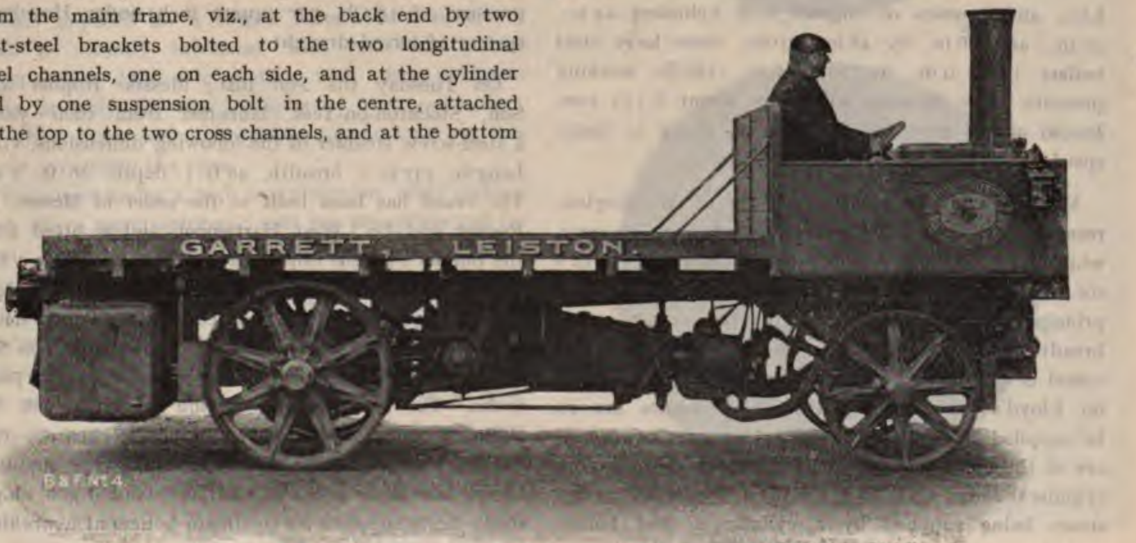


FIG. 4. GARRETT 4-5-TON STEAM MOTOR LORRY.

SHIPBUILDING NOTES.

ON Tuesday afternoon the s.s. *Othello* was launched from the yard of the Northumberland Shipbuilding Company, Ltd., Howdon-on-Tyne, the vessel being to the order of Messrs. C. T. Bowring and Co., Ltd., Liverpool. She is 353 ft. long and 47 ft. 3 in. beam by 28 ft. 3¾ in. deep, and has been built under special survey to the highest class at Lloyd's. Very special attention has been paid to the loading and discharging gear, and a complete outfit for the rapid handling of cargoes is being arranged for, consisting of seven steam winches by Messrs. Clarke, Chapman and Co., Ltd., Gateshead-on-Tyne, a large number of cargo derricks, steam steering gear by Messrs. The Harrison Engine Company, Manchester, and steam windlass by Messrs. Emerson, Walker, and Thompson Bros. The boat is fitted with the usual water-ballast arrangement for light passages. The bunkers and tank in engine and boiler space are coated with Messrs. Wailes, Dove and Co.'s patent bitumastic enamel. The machinery will be supplied by Messrs. The Wallsend Slipway and Engineering Company, Ltd., and consists of engines with cylinders 24 in., 40 in., and 66 in. by 48 in. stroke, three large steel boilers 13 ft. 9 in. by 10 ft. 6 in., 180 lb. working pressure. The steamer will carry about 6,150 tons loaded and is expected to steam at about 10 knots speed.

Messrs. R. Williamson and Son, of Workington, recently launched the steel-screw steamer *Queenie*, which has been built to the highest class at Lloyd's for Messrs. Alf. H. Keep, Ltd., London. The principal dimensions are: Length, b.p. 134 ft. 9 in.; breadth, 23 ft. 10 in.; depth, m.l.d. 10 ft. 9 in. The vessel is designed to carry about 400 tons deadweight on Lloyd's summer freeboard. The engines are to be supplied by Messrs. Ross and Duncan, Govan, and are of the compound surface condensing type, having cylinders 18 in. and 36 in. with a stroke of 24 in., steam being supplied by a cylindrical steel boiler, 12 ft. by 10 ft. working at a pressure of 125 lb.

The steel screw steamer *Anselm*, the latest addition to the well-known Booth Line of Liverpool, left the shipbuilding and engineering works of Messrs. Workman, Clark, and Co., Ltd., Belfast, on Monday morning for her speed trials and adjustments of compasses in Belfast Lough, and after a satisfactory cruise, proceeded to Liverpool to receive cargo and passengers for her initial voyage. The vessel is 415 ft. long, and her gross tonnage is 5,450; she has been built under Lloyd's special survey for their highest class. The most prominent feature of the *Anselm* is her accommodation for passengers, there being about sixty handsomely appointed staterooms on the upper and bridge decks, variously arranged in size and furnishing to accommodate one, two or three passengers. The machinery and boilers have been constructed by Messrs. Workman, Clark and Co., at their Queen's Road works and consist of a set of triple expansion engines with all the latest improvements to develop upwards of 4,500 h.p., steam being supplied by four steel multitubular boilers working at a pressure of 180 lb. per square inch under Howden's system of forced draught.

On Tuesday the 21st inst., Messrs. Ropner and Son, Stockton-on-Tees, launched from their yard, a steel-screw steamer of the following dimensions, viz.: Length, 337 ft.; breadth, 48 ft.; depth, 28 ft. 5 in. The vessel has been built to the order of Messrs. R. Ropner and Co., West Hartlepool, and is fitted with the builder's patent improved trunk deck, having a tier of hold beams in addition to the complete trunk deck, and is fitted with T. G. forecastle on trunk deck. A double bottom is provided for water ballast on the cellular principle, also in the fore and after peak tanks. The deadweight carrying capacity will be about 6,000 tons on Lloyd's summer freeboard. The engines will be of the triple expansion type supplied by Messrs. Blair and Co., Ltd., of about 1,400 i.h.p., steam being supplied by two main boilers at a working pressure of 180 lb. per square inch.

Recent Advances in Metallography.

MR. J. E. Stead, F.R.S., lectured on "Metallography" to the Royal Microscopical Society last week, dealing with the work achieved by modern investigators in this field. Of these Mr. Stead is himself one of the foremost. The lecture to the Microscopical Society was a brief history of researches, which have had an important bearing upon one of our great industries.

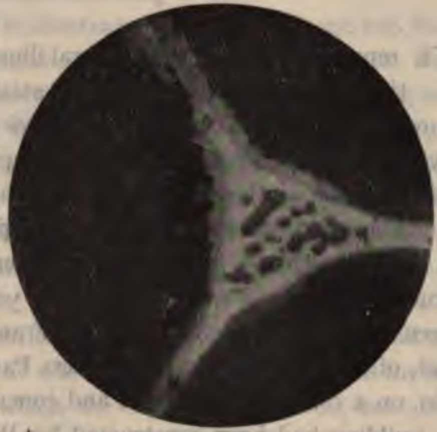
The most important part of the lecture was, perhaps, that relating to the detection of phosphorus in steel under the microscope. Mr. Stead described various methods of detecting phosphorus, and pointed out the importance of increasing the knowledge as to the incidence of impurities in steel.

Mr. Edward L. Buttenshaw read a paper before the Manchester Students' Section of the Institution of Electrical Engineers on the same subject, and the illustrations shown, reproductions of photographs shown at Manchester, are the work of Mr. Stead. The author states that one of the most important elements in steel is phosphorus. This occurs in steel up to ·07 per cent., this amount in castings is not particuarly harmful if not required to stand strain; but for forging purposes and material that has to withstand strain or shock, it should not exceed ·03 per cent.

Like sulphur, phosphide of iron aggregates to the edges of the grains. The serious nature of this weakness can be understood when considering the alternating strains imposed on a forged axle. The hardness of iron is steadily increased with each addition of phosphorus. As a rule, etching with nitric acid acts more severely on the junctions of the grains than on their mass when phosphides are present, but this is not invariably the case.

Examined under a high magnification, after etching with dilute warm sulphuric acid the phosphide can be easily detected. The more usual form of phosphide, as seen in pig-iron, has a curious speckled appearance, but is in small patches only. The author showed a specimen containing 10·2 per cent. of phosphorus and compared it with a similar specimen containing 11·07 per cent. or only ·87 per cent. more phosphorus. The crystals seen on the latter were the pure alloy of iron and phosphorus chemically known as Fe_3P.

An instance of the flow of metal under pressure is well seen in fig. 2, which represents a chisel-head that has been well used. The crushing of the grain from its original position is well seen.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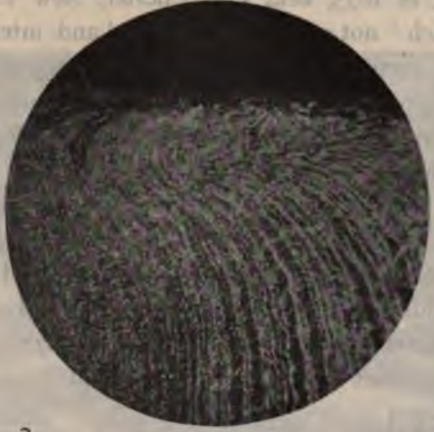
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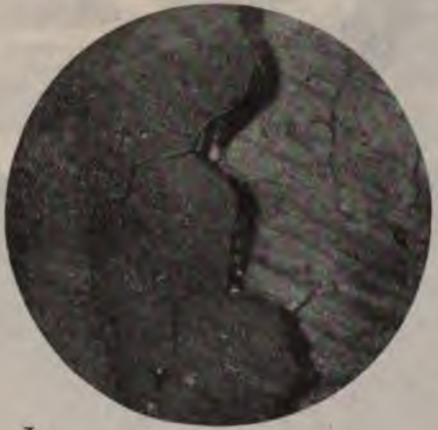
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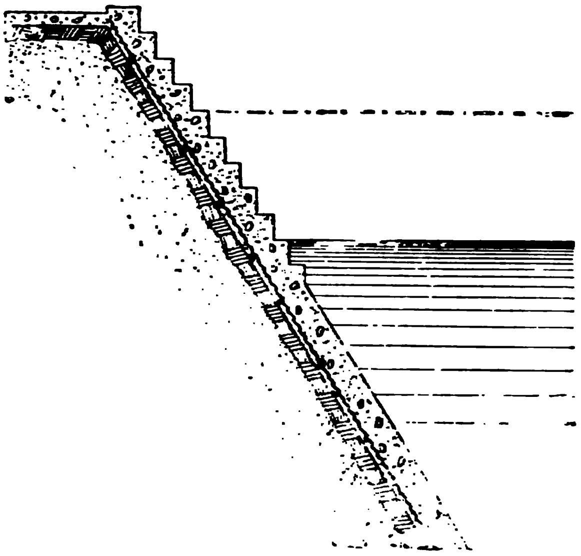
Fig. 1. Phosphide eutectic.
Fig. 2. Chisel-head after use.
Fig. 3. Copper containing bismuth.

Armoured Concrete and its Application.

WE reproduce in this issue several illustrations of the use of expanded steel in armoured concrete. In a comprehensive review of this system the New Expanded Metal Company remind us that Jean Monier, a gardener living in the neighbourhood of Paris, is generally given credit for the invention, in 1876, of the system of construction which, for five-and-twenty years, has been called by his name, although Francois Coignet, of Paris, had taken out Letters Patent in 1869, on a combination of iron and concrete, and a building had been constructed by W. E Ward, in 1875, near Port Chester, New York, in which "not only all the external and internal walls, cornices, and towers were constructed of beton (concrete), but all of the beams and roofs were exclusively made of beton, reinforced with light iron beams and rods."

In 1876 Monier needed some large pots in which to plant orange trees, and he conceived the idea of using concrete with wire netting embedded in it to give strength. He received a diploma at the Paris Exposition of 1878, and, finding that his invention covered a much larger field than he had supposed, brought the matter to the attention of engineers and capitalists, with the result that, in a comparatively short time, many tanks, bridges, sewers, and the like were built on his system in France, Germany, and Austria. It was only a step from this to the construction of fire-proof doors, large numbers of which have since been built in Europe.



SECTION OF DOCK AT HUNTER'S POINT, CAL.

It is claimed that by this combination an ideal construction is produced which is capable of wide application. The use of expanded metal ensures that the steel is well deployed in the slab, for notwithstanding its mesh form it is still remains a solid sheet.

The usual type of expanded steel for armoured concrete construction is that known as 3-in. mesh. This mesh measures 3 in. by 8 in. from centre to centre of intersections, and, obviously, each intersection is twice the sectional area of its strand. As the metal is stronger when the sheets are laid with the long way of the meshes from support to support, it is generally used in that manner.

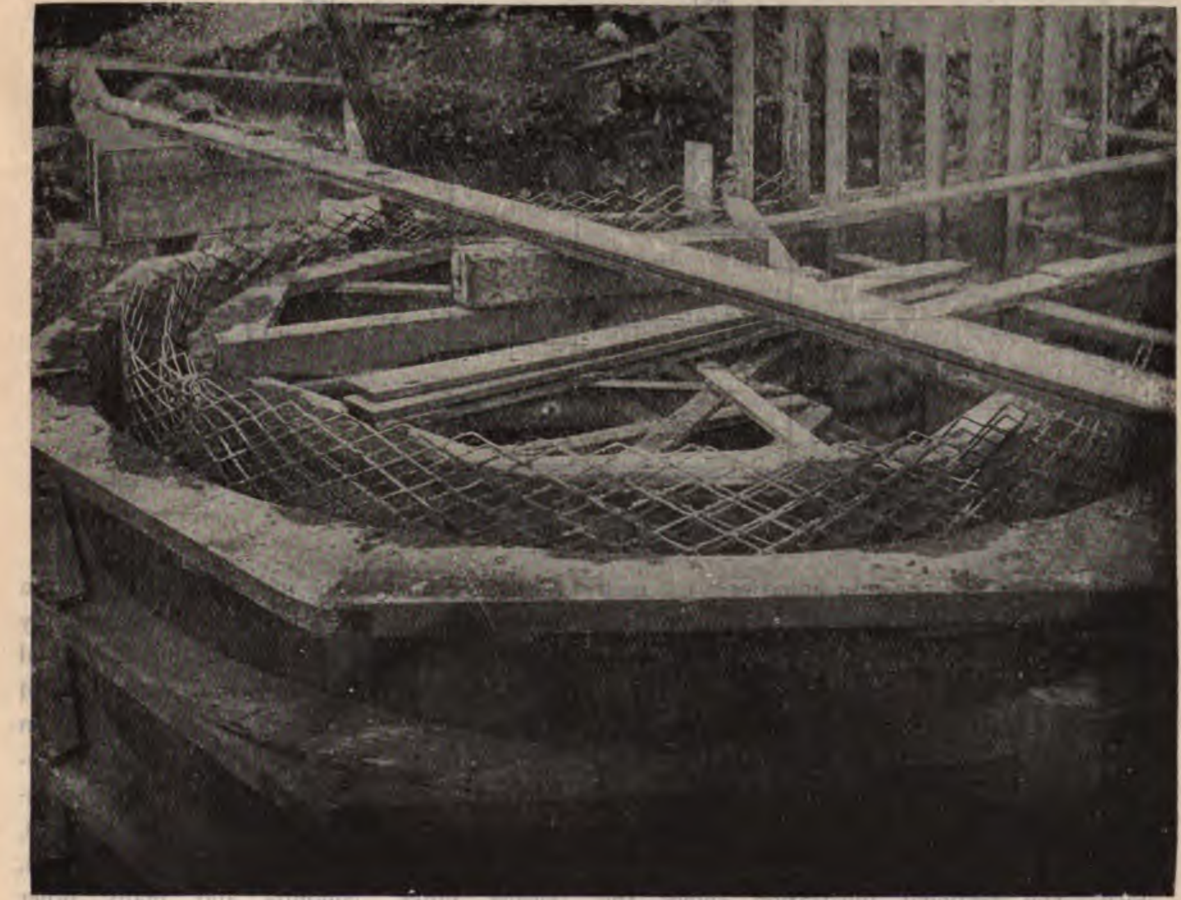
In practical working of this form of construction, after the temporary centring has been erected, the expanded steel is laid immediately upon it, with not less than one mesh lap in each direction where the sheets join. The concrete is then placed upon the steel and is thoroughly well scraped, spaded and tamped down into the meshes to ensure the metal being completely embedded, and the meshes entirely filled. This action lifts the expanded steel into its ideal position, viz., about ¾ in. from the face of the concrete.

If the concrete is to be faced, with sand and cement, or granolithic finish, the facing is applied while the concrete is green, but if this cannot be done, and the facing has to be applied after the concrete has gone off, the latter is well swept and freed from dust, wetted with clean water, and, if necessary, sprinkled with dry cement to ensure the facing taking properly to the concrete.

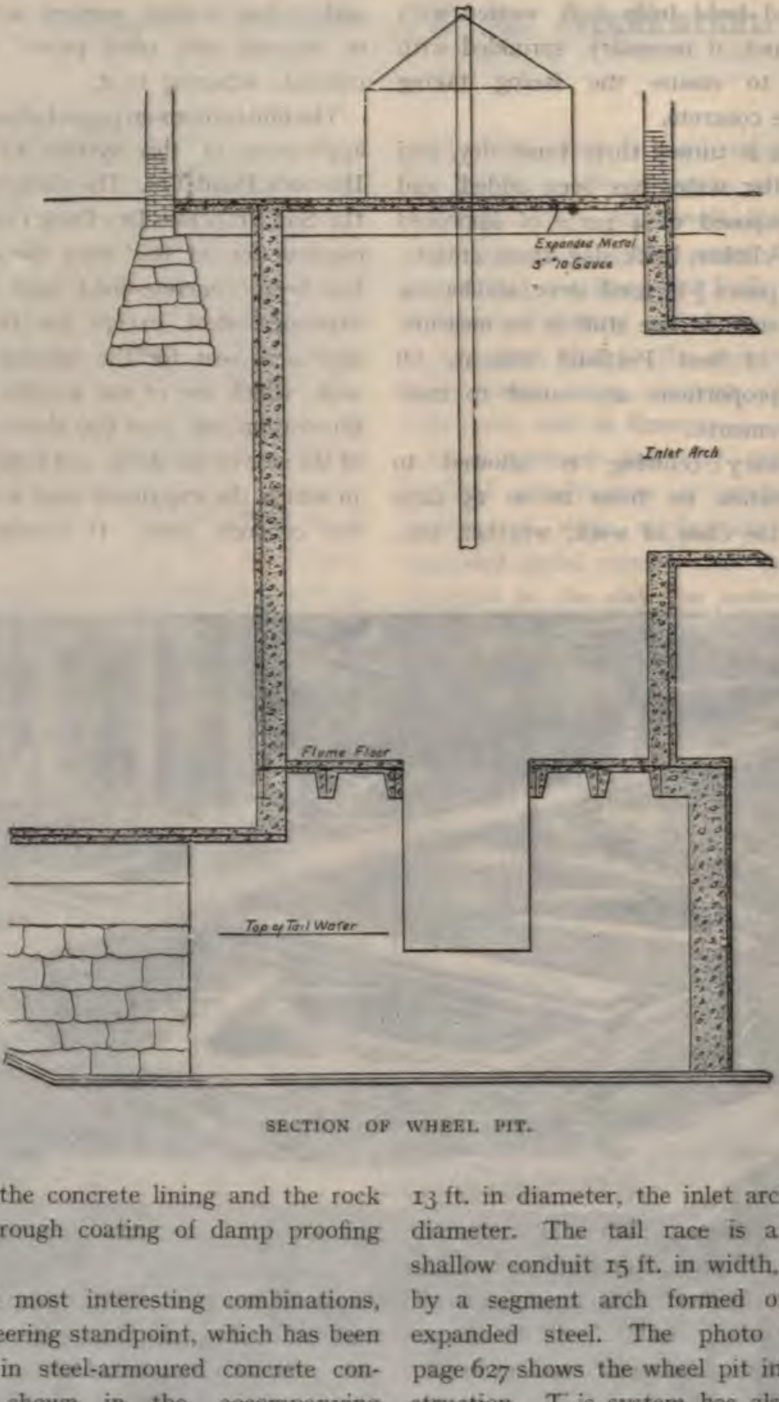
The concrete is turned three times dry, and three times after water has been added, and should be composed of 4 parts of approved aggregate, say clinker, brick, slag, stone, granite, etc., broken to pass a ¾-in. mesh sieve, and having about 30 per cent. of fine stuff in its measure, to one part of best Portland cement. Of course, these proportions are varied to meet various requirements.

The temporary centring is allowed to remain in position for from 10 to 15 days according to the class of work, weather, etc., and is lime-whited, washed with soap water, or covered with oiled paper, to prevent the concrete adhering to it.

The illustrations on pages 616 and 626 show the application of this system to dock work at Hunter's Point, Cal. The plans were prepared for the San Francisco Dry Dock Company. In the construction of this dock the entire chamber has been concrete-lined and reinforced with expanded steel, except for the sides of the approach, seat for the caisson and the apron arch, which are of cut granite masonry. The illustration on page 626 shows a small section of the side of the dock, and indicates the manner in which the expanded steel was used to bond the concrete sides. It should be mentioned



WHEEL PIT OF STEEL ARMOURED CONCRETE, IN PROCESS OF CONSTRUCTION.



SECTION OF WHEEL PIT.

that between the concrete lining and the rock surface, a thorough coating of damp proofing was used.

One of the most interesting combinations, from an engineering standpoint, which has been accomplished in steel-armoured concrete construction is shown in the accompanying illustrations of a wheel pit, including an inlet arch, flume floor, generator floors and tail race. The sectional illustration shows the general form of the work. The wheel pit is 13 ft. in diameter, the inlet arch being 8 ft. in diameter. The tail race is a comparatively shallow conduit 15 ft. in width, and is covered by a segment arch formed of concrete and expanded steel. The photo reproduced on page 627 shows the wheel pit in course of construction. This system has also been successfully employed for fireproof floors, foundations, reservoir work, factory construction, bridges, sewage tanks, conduits and many other purposes.

THE UGANDA RAILWAY.

By J. D. F. LEYLAND.

(Continued from page 579 and concluded.)

FOUR classes of engines were used, namely, A and E class engines, which were small and light, and used for shunting and stores work; N class, used for construction and railhead purposes; and F class, which have been specially constructed for the railway, and are very powerful. The A, E, and N classes were second-hand engines purchased from India. The total weight of engine and tender in A class is 17 tons, in E class 28·5 tons, in N class 36 tons, and in F class 50·1 tons.

PLATE-LAYING

The rate of plate-laying varied a great deal. The plate-laying gangs, when not hindered by heavy work, and when sufficient material could be brought up, were quite capable of doing one mile per day, and often did nearly one-and-a-half miles. The first party of coolies arrived from India in January, 1896, and in August of that year the Macupa temporary bridge from the island was completed, and plate-laying began on the mainland on August 5th, 1896.

The progress of plate-laying is calculated from this place and date.

	Mile
On March 31st, 1897, railhead had reached	40
,, 1898, ,, ,,	139
,, 1899, ,, ,,	279
,, 1900, ,, ,,	362
,, 1901, ,, ,,	483
On Dec. 20th 1901, ,, ,,	584

Mile 584 is the terminus of the line at Port Florence. The average amount of plate-laying done in twelve months was about 106 miles. The temporary bridges were mostly trestle bridges.

ROPE INCLINE.

The work on the permanent line for the descent of the escarpment into the Rift was very heavy, including several viaducts, and it was found necessary to construct at great cost a temporary rope incline, by which permanent way material could be lowered, pending the completion of the work on the Uganda line. In the House of Commons it was remarked that this rope incline was a great waste of money, and it was asked why it was built. Lord Cranborne, in replying, said that, by building the incline, we had reached the shores of the Lake at least twelve months earlier than we otherwise should have done; and that the railway was hurried on because two other Powers were competing with Great Britain for the possession of Uganda.

There were really four inclines, the total length of which was 6,040 ft., and the total descent 1,522 ft. The top incline was 1,570 ft. long, and fell 221 ft., and the steepest gradient was 1 in 7. The second incline was 1,150 ft. long, and fell 445 ft., the steepest gradient being 1 in 2·15. The third incline was 1,560 ft. long, and fell 695 ft., and the steepest gradient was 1 in 2. The bottom incline was 1,760 ft. long, and fell 161 ft., the greatest gradient being 1 in 6. Wagons could run down inclines 1 and 4 on their own wheels, but there were special carriers on inclines 2 and 3. An average of four wagons could go up and four down the inclines per hour.

TRADE AND INDUSTRY OF THE COUNTRY.

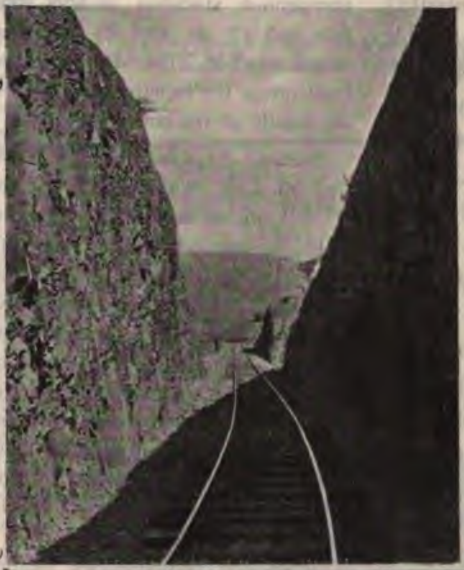
The traffic consists mostly of merchandise exports, and imports, protectorate stores, live stock and passengers. The following are the chief commodities under the head of merchandise: ivory, grain and pulse, sugar, provisions, building materials, and fruit and vegetables. With the coming of the railway the trade and industry of the country are improving wonderfully. In East Africa there is an abundance of ostriches, and there ought to be no difficulty in establishing ostrich farms. Indiarubber is plentiful. There is a great deal of pasture and arable land. In Uganda proper, manufactured articles of personal and agricultural use are much in demand. The export trade consists almost exclusively of ivory, but the Waganda, who are an intelligent people, are taking great pains to foster native products, and they are expert in iron working.

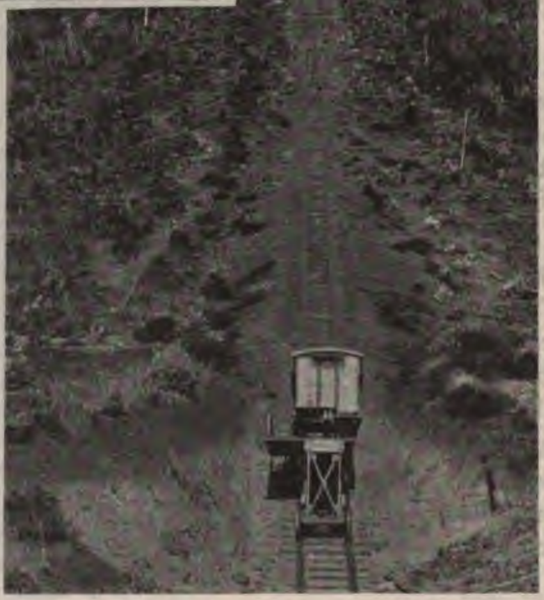
COST.

In 1893 Major Macdonald estimated that the whole railway would cost £2,240,000, or £3,409 per mile. This estimate had to be prepared with very little knowledge of the country and its conditions, and without a proper survey being made. In 1899, when all the surveys had not been quite completed, the chief engineer estimated that it would cost £4,930,000, or £8,505 per mile. When the final surveys were completed, it was estimated that the total cost would be £5,550,000, or £9,501 per mile, which was a net increase of £600,000 over the estimate of 1899. (Details of the revenue accounts from the latest report appeared in the last issue, page 559.) There were four chief reasons for this excess. First, the chief engineer took the finished part of the line as a guide, but it proved to be much less difficult than the uncompleted part. Secondly, he had very imperfect knowledge of the climatic conditions of the country to be traversed, and in the two succeeding years there was a great

MEMBERS OF THE RAILWAY CONSTRUCTION STAFF.

The Manager and Chief Engineer Sir George Whitehouse, K.C.B., is in centre of group (with dog). On the right in the following order are Mr. [illegible] Anderson, C.M.G., Assistant Chief Engineer; Mr. [illegible] Harwood, Chief Accountant; Mr. C. [illegible], C.E., Locomotive Superintendent (in light suit), and Mr. F. [illegible], C.E., Assistant Manager. Dr. [illegible], the Medical Officer (with beard) is on the left of Sir George Whitehouse, K.C.B.





(1) Cutting at Mile 525, near Fort Ternan.

(2) View of temporary rope incline showing carrier nearing pit.

deal of heavy tropical rain which stopped all work. Thirdly, he took the price of stores from England to be the same as in previous years, but the rise in price of coal upset all calculations in this respect, and could not possibly have been foreseen. Fourthly, he was unable to foresee certain additional works, the advisability of them not becoming apparent until some time after the estimate was sanctioned. The under-estimate in the case of the Uganda Railway was not comparable with that in the case of the Manchester Ship Canal, and works of this kind are generally under-estimated.

STAFF.

The engineering staff of the line was as follows: one chief engineer, one chief assistant engineer, one chief draughtsman, one assistant draughtsman, two superintendents of works, seven district engineers, twenty-three assistant engineers, one locomotive superintendent, three assistant locomotive superintendents, one workshop manager.

Finally, it should be remarked that the Uganda Railway has not in any way brushed off the picturesque charm or wildness of the country, still less of the people through whose country it passes. It is not, even now, at all a humorous exaggeration to say that the wayside landscapes remind the traveller of that series of pictures in "Punch" entitled "Prehistoric Peeps." On the platforms naked savages, carrying elaborate ornaments, often including old jampots in the slits cut in their ears, peer and grin with good-natured curiosity at the uncanny objects which engineers have sent among them.

The accompanying illustrations are reproduced by the courtesy of the Foreign Office.

SHIPBUILDING NOTES.

Messrs. William Gray and Co., Ltd., recently launched the steel screw steamer [illegible] for Messrs. [illegible], West Hartlepool. She will take the highest class [illegible] and is of the following dimensions: [illegible] length [illegible] ft.; breadth [illegible] ft. [illegible] with long bridge poop and topgallant forecastle. The hull is built with deep frames, cellular double bottom, and large aft peak ballast tank, six steam winches, steam steering gear amidships, hand screw gear aft, patent direct steam windlass, large patent donkey boiler, shifting boards throughout, stockless anchors, telescopic masts with fore and aft rig, and all requirements for a first-class cargo steamer. The ship and machinery have been built under the superintendence of Mr. C. P. Sanderson on behalf of the owners.

The s.s. *Augusta*, built by Messrs. W. Dobson and Co., of Low Walker-on-Tyne, to the order of Mr. P. A. Gron, of Sandefjord, Norway, left the Tyne last week, for her official trial trip, after which she sailed on her maiden voyage. The vessel, which has been built to highest class Norwegian Veritas, is of the following dimensions: length between perpendiculars; 338 ft.; breadth, 48 ft.; depth moulded, 28 ft.: and has a dead-weight carrying capacity of about 6,000 tons. She is of the type of vessel of single deck class, with poop, bridge, and forecastle, and has been specially constructed for the owner's iron ore trade, between Norway and Rotterdam, with large deep tank for water ballast fitted amidships. Nine large steam winches are provided for dealing with the cargo. The propelling machinery, which has been constructed by the North-Eastern Marine Engineering Company, Ltd., at their Northumberland Engine Works, Wallsend-on-Tyne, consists of a set of their latest type of triple expansion surface condensing engines, having cylinders 24 in., 39 in., and [illegible] in., with 45 in. stroke, steam being supplied by three large steel boilers working at a pressure of 180 lb. per square inch. A good speed was maintained on the trial run and the engines worked without the slightest hitch. There were numerous visitors present during the run, including the owner, Mr. P. A. Gron, Mr. W. J. Jobling and Capt. Christensen, under whose supervision the vessel and engines have been built, Mr. H. Dobson and Mr. W. Dobson, representing the shipbuilders and Mr. J. Daglish, representing the engine builders.

There was recently launched from the shipyard of Messrs. Cochrane and Sons, shipbuilders, Selby, a handsomely-modelled steel screw trawler, the principal dimensions being [illegible] ft. [illegible] in. by [illegible] ft. by [illegible] ft. [illegible] in. depth of hold. The vessel has been built to the order of Messrs. The Grimsby Atlas Steam Fishing Company, Ltd., Messrs. Letten Bros., Grimsby, and is being fitted with powerful triple expansion engines by Messrs. Charles D. Holmes and Co., of Hull. She is replete with all the latest improvements for this class of vessel.

OUR WEEKLY BIOGRAPHY.

PROFESSOR JOHN OLIVER ARNOLD.

PROFESSOR JOHN OLIVER ARNOLD was born in 1858. He was educated at King Edward's Grammar School Birmingham, and on the conclusion of his studies there he was enrolled as a cadet on H.M.S. *Conway*, and subsequently joined the Royal Naval Reserve as a midshipman. When he reached the age of twenty he went to Sheffield and entered the Engineering Department of the Sheffield Steel and Iron Works, where, after he had gained experience in the laboratory and testing departments he became the firm's chief chemist and testmaster. His next appointment was at the Farnley Ironworks, Leeds. This was followed by two years as chemist and manager of the Spanish Steel Works, Sheffield, in which city he also practised as a consulting metallurgist and chemist

In 1887 the Institution of Civil Engineers awarded him the Telford Premium for his paper on the influence of chemical composition on steel tyres. Two years later he was appointed to his present position as Professor of Metallurgy at the University College of Sheffield, which was then known as the Sheffield Technical School. In 1895 he was again awarded the Telford Premium, and, in addition, a gold medal for his researches on the influence of carbon on iron. The Institution of Engineers and Shipbuilders in Scotland awarded him in 1898 a premium for his lecture on the internal architecture of metals, and quite recently the Iron and Steel Institute conferred upon him the Bessemer Gold Medal.

Photo by Elliott and Fry.

PROFESSOR JOHN OLIVER ARNOLD.

During the last two years Professor Arnold has been engaged in reorganising the steel and iron laboratory at the Sheffield University College, which promises to be one of the finest equipped institutions of its kind. It will contain a full-sized experimental plant which will serve to demonstrate the three standard methods of steel manufacture—crucible, Siemens and Bessemer. The scale upon which instruction has already commenced in this laboratory is exemplified by the fact that during the current session about forty tons of iron castings have been made from the new experimental 40-in. cupola. The motive power throughout is electricity; and the foundry is spanned by a 4-ton travelling crane.

Professor Arnold is one of the three technologists appointed as special lecturers to the British Association during the forthcoming visit to South Africa.

NAVAL NOTES.

GREAT BRITAIN.

THE month of March has been a very quiet one so far as launches are concerned, only the destroyer *Nith* and two submarines, *A8* and *A9*, having taken the water to date, all these on the 7th of the month. But in trials there has been much more doing, and apart from the *Carnarvon*, to which reference was made last week, the *Devonshire*, *New Zealand*, and *Pathfinder* have all entered upon the trial stage. The *Devonshire* at her one-fifth power trial made 13·07 knots, with 4,533 h.p., and a coal consumption approximating to 2 lb. per i.h.p. per hour.

Lord Brassey, in a paper read before the Institution of Civil Engineers last week pleaded for the construction for the British navy of more vessels of small displacement, vessels of from 10,000 to 12,000 tons burthen as heavily armed and protected as the larger vessels we are now building, but with less speed and smaller coal capacity. He pointed to the movement in this direction in the navies of France and Italy, and held that what those countries considered advisable could not be wholly disregarded by British naval administrators, and no naval country was so wealthy as to make unlimited appropriations to new construction.

FRANCE.

Reports have been appearing in the papers to the effect that France has determined to abandon the construction of submarines and to build only submersibles for the future, but the reports are somewhat premature. It is true that the submarine *Z* has been found in comparative trials with the submersible *Aigrette* to be a very inferior type of vessel, but this is considered to be mainly due to the faulty design of the *Z*, and the opinion of French experts that the submarine can be largely utilised for defensive purposes, the submersible for offensive purposes is by no means changed, nor is there any intention of unifying the two types. What is proposed is that the displacement of the submersible classes should be increased to 400 tons, and that of the submarine designs to 100 tons.

GERMANY.

Several more vessels are expected to take the water from the German yards this year, although a large number were got off the stocks in 1904. The principal vessels will be the battleships *O* (building at Stettin), and *P* (building at Wilhelmshaven), the armoured cruiser *C* (building at Bremen), and three protected cruisers, the *V*, *Ersatz Alexandrine* and *Ersatz Meteor*. These last-named vessels are building at the Weser Yard, at Kiel, and at Dantzic respectively.

UNITED STATES.

The statistical data published on the subject of the construction of the battleship *Louisana* and *Connecticut* make very interesting reading. These two vessels are building, it will be remembered, at a private yard (the Newport News Company), and a public establishment (the New York Navy Yard). The results of the investigations held into the comparative rates of progress made by the two vessels show that whereas the private company has not made any special effort, and work on the *Louisana* has been performed in the regular way and under normal conditions, the Navy Yard has had to put forth unusual effort and energy to maintain the requisite rate of progress. The reasons for this are mainly industrial, it being held that higher rates of wages are paid at the Navy Yard than by private companies in Greater New York and elsewhere, and the rates of the latter average higher than companies elsewhere. Employment the year around is steadier and more secure than in private yards. The higher wages, shorter hours and steady employment attract the best grade of workmen to the Navy Yard, where a tacit recognition of an asserted economic theory prevails, that the best workmen cannot be induced to work extra hard without larger pay than the average. The following reasons are also stated: The expectation or belief that if the *Connecticut* was built in record time the building of another battleship would be given the Brooklyn Navy Yard; a zeal generated by the general challenge of the country to the Navy Yard workmen to make good their claims in this test; prompt discharge for inefficiency; dismissal of workmen who could not or would not come up to a required standard of output in quantity and quality; no restriction of output individually or collectively; loafing, soldiering or "marking time" not tolerated; workmen required to begin work the moment the whistle blows, and to continue working until the moment the whistle blows at quitting time; strict technical and exacting supervision of a high order of skill and experience; a desire on the part of naval constructors and workmen to remove an impression of inefficiency growing out of former Navy Yard construction of war vessels, before civil service regulations controlled employment there.

30-in. DUPLEX BORING AND TURNING MILL.

BY MESSRS. WEBSTER AND BENNETT, COVENTRY.

THE machine illustrated on this and the following pages is the latest double-boring mill constructed by Messrs. Webster and Bennett, of Coventry. It weighs 5 tons 13 cwt., and has been designed to occupy a minimum of space. The advantages of an arrangement which enables one man to keep two tools working to their full extent are of course obvious. The machine can be used for work up to 30 in. diameter by 18 in. deep. The accompanying line drawings illustrate the more interesting points in construction, and the firm's explanatory notes upon these are given below.

The driving cone pulleys are at the back, and their axes are parallel to the greatest length of the machine, thus enabling the mill to be fixed in line with the main shop shafting, instead of at right angles to it, as is sometimes necessary. The driving gear is mounted inside the base, and works in either single or treble ratio, thus giving power for heavy cutting. The change of gear is made by handles at the front, which control friction clutches of the toggle expanded ring type, by means of which the speed of the heavy tables may be changed instantly and without shock. This change, together with two speeds on each countershaft, gives four speeds of table without shifting the cone belt.

Fig. 2 shows section of the spindle and bearing. A large spur gear is secured to the underside of the face-plate or chuck. This form of gear, which is 30 in. diameter, and is driven by a pinion, is preferred to bevel driving, as there is with it no tendency to lift the spindle. The pressure ring is directly under the spur gear, and runs in oil. This ring is supported by a column of metal carried straight from the floor line, and imparts a degree of solidity which is specially valuable when dealing with

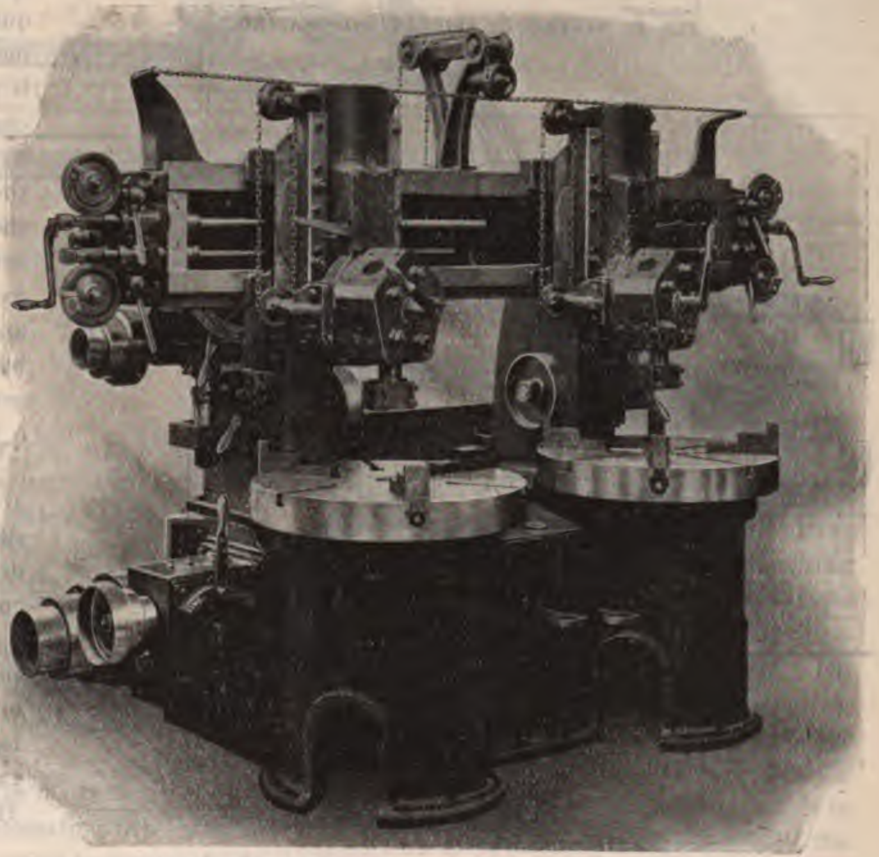


FIG. I. 30-IN. DUPLEX BORING AND TURNING MILL.

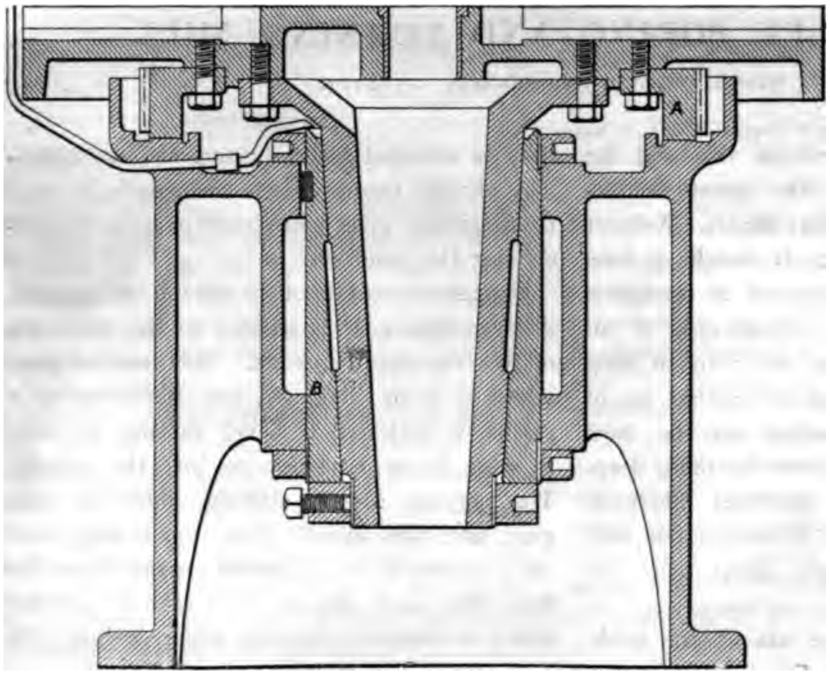


FIG. 2. SECTION OF SPINDLE AND BEARING.

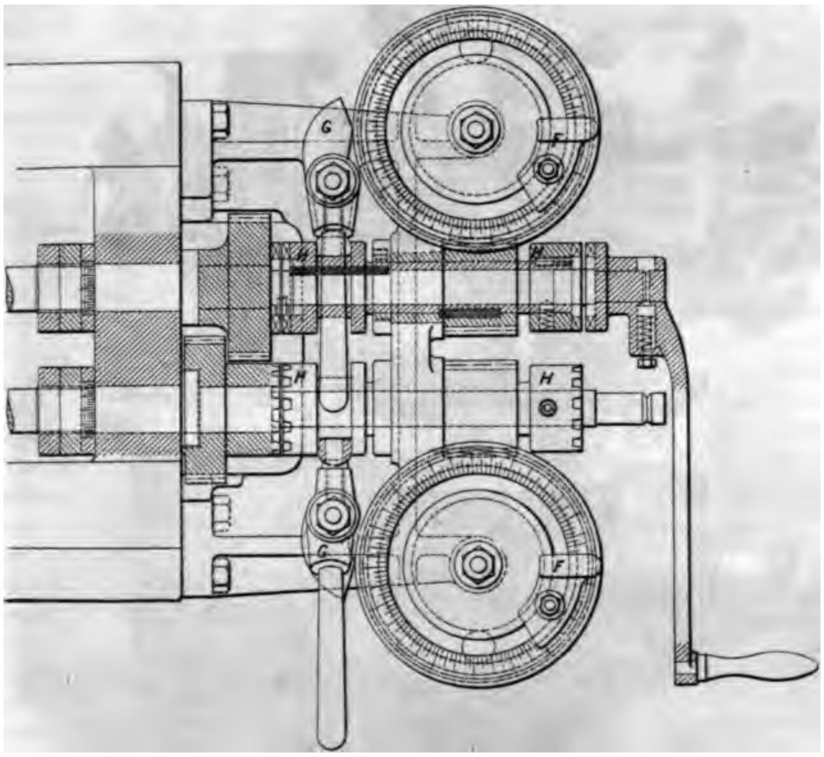


FIG. 3. AUTOMATIC TRIP MOTION.

heavy work. The spindle itself has therefore to take the side thrust only. It is bolted directly to the face-plate, and runs in a long conical bush B, which may be adjusted by nuts top and bottom. The oil reservoirs can be filled without disturbing any work or fixtures on the face-plate. The cuttings fall through the spindle. Bushes for boring bars may be inserted in the face-plate.

The feed motion (fig. 4) is driven by a three-speed cone pulley. A quick movement by means of a hand lever C is provided for use when changing from roughing to finishing, and saves the necessity of shifting the belt when the most suitable speed has been fixed upon. This simple arrangement is preferred by many users to more complicated gears giving a long range of feeds.

The vertical feed shaft at the back of the cross slide is capable of being driven slowly when a cutting feed is required, and quickly when the slides are to be returned or advanced. The cutting feed is driven by the cone pulley, and worm gear D. The power quick return

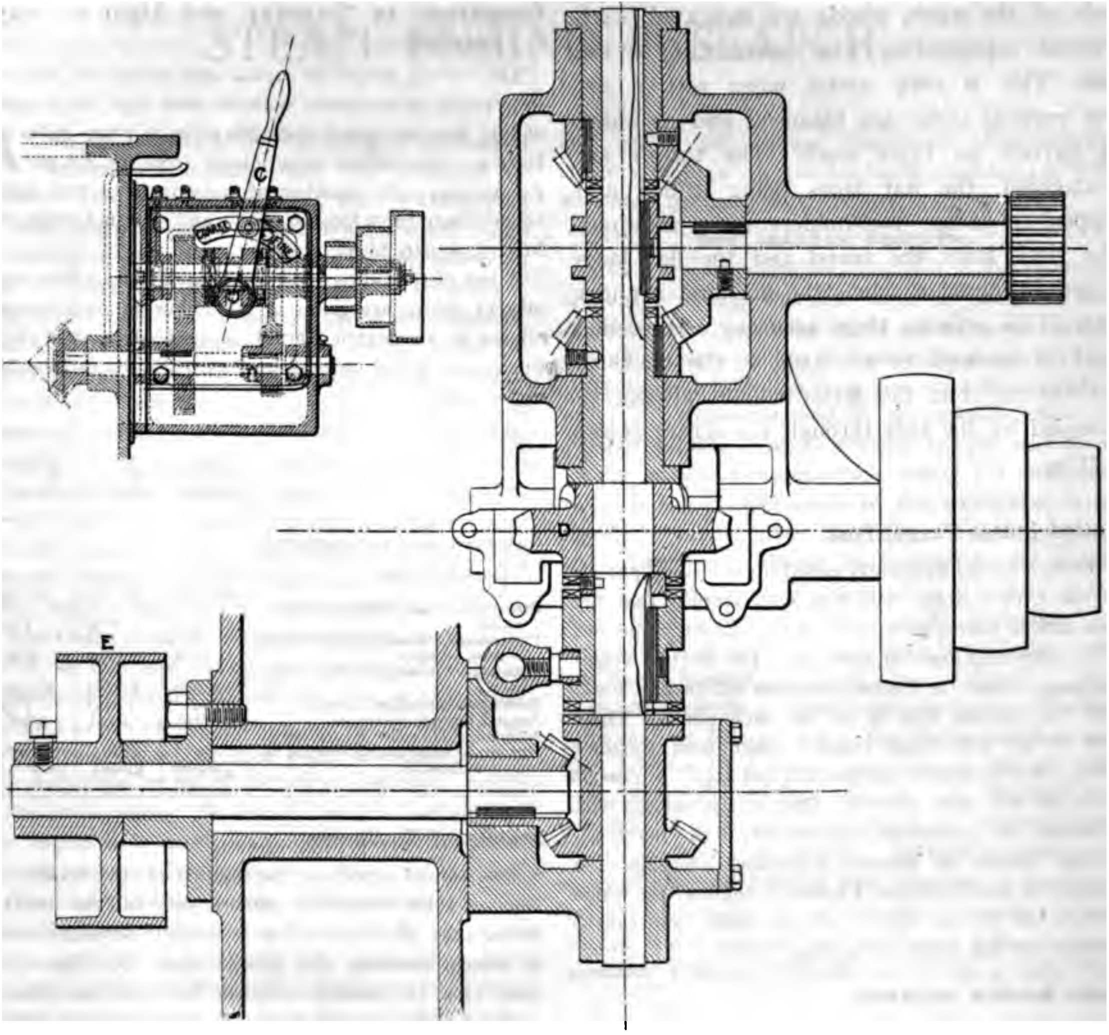


FIG. 4. FEED GEAR.

is driven by the pulley E, which is belted directly to the countershaft, and runs at a constant speed. The clutch which controls this motion is operated by a hand lever. The direction of the travel of the slides is reversed at will by means of the bevel wheel and pinion seen at the top of the section. The motion is delivered to the gearing at the end of the cross slide by the pinion at the end of the bevel wheel shaft. This motion, it may be remarked, is a patented feature of the machine.

Fig. 3 shows the automatic trip motion. The trip dogs F are carried by worm wheels, whose movements always bear a fixed relation to the tool. At the termination of the cut the dogs strike the lever G, which withdraws the clutch from the feed gear. This sliding clutch H is double-ended; the teeth on the one end engage with the feed gear, and those on the other end with the crank handle. The whole clutch, however, is not long enough to engage both ends at once. By this means the crank handle always hangs stationary when the automatic feed or the power quick return is in action, thus saving any risk of accident if the operator neglects to remove the crank. The dials on the worm wheels are indicated, each division representing $\frac{1}{8}$ in. movement of the tool. This is very useful when setting up. The vertical slides are balanced and mounted on swivels for taper work. The turrets are pentagonal, the flat faces being drilled and tapped to secure tool-holders when required. The large holes are bored and the flat faces milled in position when the machine is under test. This ensures their accuracy. Hardened steel division plates are fixed to the backs of the turrets, but the latter should always be clamped by the bolt through the centre before cutting.

United States Parcel Post.

Those who are frequently called upon to send parcels to the United States will note with interest that the new official parcel post between that country and our own comes into force on April 1st. The limit of weight for parcels from the United Kingdom will be 4 lb. 6 oz., and the postage will be 2s. for each parcel. There will be no non-postal charges apart from Customs duty. The insurance system will not apply to parcels sent by the new service. This official service will, however, be carried on concurrently with the semi-official service at present maintained through the agency of the American Express Company, by which parcels can be sent up to 11 lb. in weight, and can be insured for any value up to £120.

Tube Scheme Deferred.

The Hammersmith, City, and North-East London Railway Bill was recently before the House of Commons Committee on Standing Orders, the proposal being to construct an electrical tube line from Hammersmith to the City, whence branches would communicate with Palmer's Green and Walthamstow. The estimated cost of the line, about twenty miles in length, was £6,000,000. The Examiner of Standing Order Proofs reported instances in which there had been non-compliance with standing orders. The promoters appealed for a dispensation, but the committee, after deliberation, decided not to recommend that the standing orders should be dispensed with. The effect of this decision is that the Bill will not proceed during the present Session of Parliament.

A correspondent seeks information as to method of calculating ratios obtainable in epicyclic gearing for change speed gear on motor-cars.

Comparison in Tramway and Light Railway Practice.

The annual return of capital and traffic for 1903–4 shows that, as compared with the year 1878, the length of line has increased from 269 miles to 1,840 miles in 1903–4; the capital expenditure from £4,207,350 to £46,451,444; the number of passengers carried from 146,000,000 to 1,799,000,000; and the net receipts from £230,956 to £2,912,110.

A few of the ratios and percentages derived from the present return are given in the following table, which relates to an electric period, as compared with 1898 (maximum steam period), and 1879 (an almost wholly horse period):—

—	1903-4. Electric Period.	1898. Steam Period.	1879. Horse Period.
Capital expenditure per mile of single track open:—			
Lines and works	£11,780	£7,770	£7,840
All items	£16,018	£10,469	£9,877
Percentage of net receipts to capital outlay	6·27	6·38	3·97
Percentage of working expenditure to gross receipts	66·15	76·93	83·81
Passengers carried per mile of route open	977,951	806,703	469,641
Passengers carried per car mile ...	9·23	9·48	7·77
Average fare per passenger	1·11d.	1·23d.	1·84d.
Amount paid in relief of rates out of profits of undertakings worked by local authorities	£207 087	(Not given)	(Not applicable)

Society of Engineers.

The annual report of the Council of the Society of Engineers for 1904—the jubilee year of the Society states that the Society has materially advanced alike in status, finances, and membership. On December 31st, 1904, the number enrolled, viz., 550, was greater than at any period in the Society's history. This total is the more gratifying as the losses from death, resignation, and other causes during the year amounted to thirty. The number of members and associates elected during the year reached the satisfactory total of forty. The Council report that Mrs. Williams, who died on December 2nd, 1904, bequeathed to the Society the portrait in oils of her late husband, Mr. Alfred Williams, one of the founders of the Society, who for forty years was its Honorary Secretary and Treasurer. The portrait has been placed in the collection of portraits of Past-Presidents in the Society's Offices, as requested by Mrs. Williams in her will. The Council have awarded premiums to the following authors of papers: Mr. W. Edward Storey, President's Gold Medal; Mr. R. G. Allanson-Winn, Bessemer Premium of Books; Mr. A. S. E. Ackermann, Society's Premium of Books; Mr. Frank Latham, Society's Premium of Books.

STEAM ENGINE RESEARCH.

AT the last meeting of the Institution of Mechanical Engineers a notable paper was presented by Professor David S. Capper, being the "First Report to the Steam Engine Research Committee," and incorporating the results of experiments extending over six years on jacketed and unjacketed cylinders.

A special engine was obtained from Messrs. Marshall, Sons and Co., of Gainsborough, and erected in the Engineering Laboratory at King's College. The engine thus obtained is a horizontal compound engine. The cylinders, which are side by side, are 6½ in. and 11½ in. diameter, by 14 in. stroke, and the connecting rods drive cranks placed at right angles. The arrangement of the engine and connections is shown in fig. 1.

Each cylinder is separately jacketed on the barrels and the ends, the supply and drain from the ends being separate from that for the barrel. Each cylinder is fitted with a Meyer expansion valve, adjustable by hand, so that the cut-off can be separately varied between one-quarter and five-eighths of the stroke. By grid valves on admission and exhaust sides, either cylinder can be arranged as a simple engine, and by blocking either of the Meyer plates the engine can be made single-acting. In any of its varied adjustments the engine is as nearly as possible an ordinary commercial engine.

The boiler available was a Davey-Paxman semi-portable locomotive working up to 150 lb. per square inch pressure, and capable of evaporating about 1,000 lb. of water per hour. The condenser is a cylindrical copper condenser with 50 square feet of cooling surface, the tubes being externally cooled.

SCHEME OF EXPERIMENTS.

The committee decided that the first series of trials should be made with the engine arranged as a single-cylinder high-pressure engine, non-condensing jacketed, the second series being a repetition of the first series but without jackets. Ater a careful study of previous experiments, it was further determined that the variables should be temperature and speed; cut-off, and all other conditions being kept constant. Temperatures of 245 deg. F., 280 deg. F., 315 deg. F., and 350 deg. F., were chosen, so as to give equal intervals between successive trials of the series. These temperatures correspond to about 27, 49, 84, and 135 lb. per square inch absolute respectively, at the engine steam-chest. The chosen speeds were 50, 100, 150, 200, and 250 revolutions per minute, corresponding to piston speeds of about 117, 334, 350, 467, and 584 ft. per minute respectively. For reasons stated in the paper, it was not found possible to adhere absolutely to these speeds and temperatures.

THE LEAKAGE PROBLEM.

Attention was particularly directed to the question of leakage through the slide valve, or piston, to the exhaust, which, of course, would not be shown on the expansion curve of the indicator diagram. Messrs. Callendar and Nicholson have shown that such leakage may be considerable, and in the present trials an attempt has been made to measure, analyse, and allow for the various leakages which occur. On analysing the results of experiments in this connection, it is found that under given conditions the leakage when the barrel of the cylinder was warmed by the jacket was considerably less than when it was cold. And it is shown that the proper correction to employ will be that obtained with the cylinder ends and barrel warmed.

In all except the 50 revolution trials there is a distinct reduction in leakage when the sliding surfaces are well lubricated, over the corresponding leakage with scant lubrication. This effect is not, however, so constant or so large as to warrant any definite quantitative analysis of the results. The cases in which such a reduction was observed were, however, so numerous in individual trials as to definitely prove that where the oil film is uniform and continuous leakage is appreciably reduced. The curves on fig. 2 show this

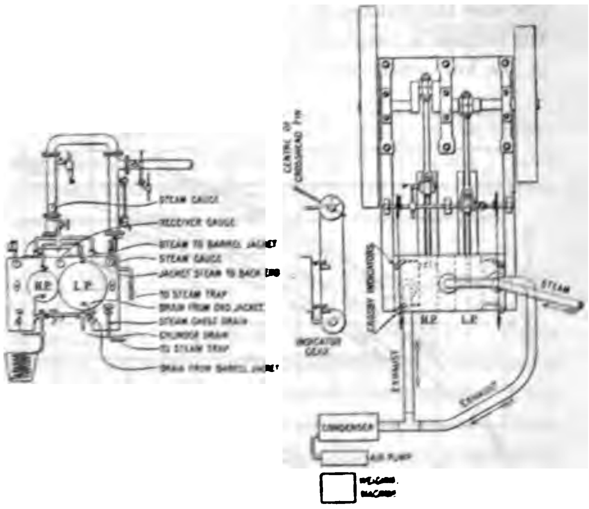


FIG. 1. SHOWING ARRANGEMENT OF ENGINE AND CONNECTIONS.

clearly, although the reduction diminishes with increase of pressure. It is interesting to note on the curve for the well-lubricated jacketed trials that where in one instance the lubrication failed the leakage at once runs into and above the curve for scant lubrication.

EFFECT OF PRESSURE UPON LEAKAGE.

The leakage, as would be anticipated, rises with an increase of pressure between steam-chest and exhaust. Where the valve is stationary in mid-position the leakage increases approximately as the pressure. Where the engine is running, however, the leakage does not increase so rapidly as the pressure, and the higher the speed the larger does this divergence become. It is evident that this bears a striking resemblance to the laws governing condensation and re-evaporation on the cylinder walls of steam engines, and when the amount of the leakage and its reduction by jacketing is considered, the conclusion arrived at by Messrs. Callendar and Nicholson is irresistible, that, much of the leakage must be in the form of moisture condensed on the valve face and re-evaporated as it passes over into the exhaust.

As bearing upon the above point experiments were made to determine what effect wire-drawing, and therefore superheating the steam previously to its entering the steam-chest, has upon leakage, and a table drawn up showing a reduction of about 25 per cent. in the leakage if wire-drawing to the extent indicated in the table be resorted to.

There is considerably less leakage when the engine and therefore the valve is stationary in mid position, but when the valve is moving there is appreciably less total leakage per hour when the engine is making 250 over the leakage at 50 double strokes per minute. The leakage is consistently less at the high speeds than at the low, where the cylinder walls are jacketed and the surfaces lubricated. This may partly be due to a more perfect spreading of the oil film at the higher speeds, or it may be due to the reduced time allowed for condensation and re-evaporation, or to a combination of the two. This clearly demonstrates that leakage was not in the present instance produced by the lifting of the valve in working, but by a more or less steady flow of moisture or steam between the valve and slide-face. The persistent and considerable difference between the leakage, when the engine is still with the valve in mid-position and when it is running, points strongly to the conclusion that the amount of overlap and its variation has an important effect upon the leakage.

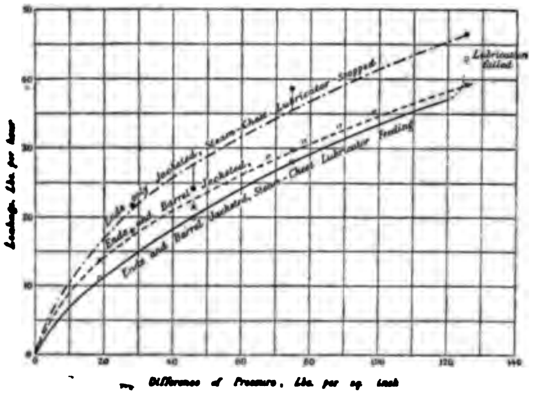


FIG. 2. CURVES SHOWING EFFECT OF LUBRICATION ON LEAKAGE.

The leakage is not directly proportional to the pressure for all speeds, and there is reason to doubt whether it is exactly inversely proportional to the overlap. But these assumptions are sufficiently accurate if suitable values of the factor are introduced to enable an approximate correction for leakage to be made by their aid.

PERCENTAGE OF LEAKAGE.

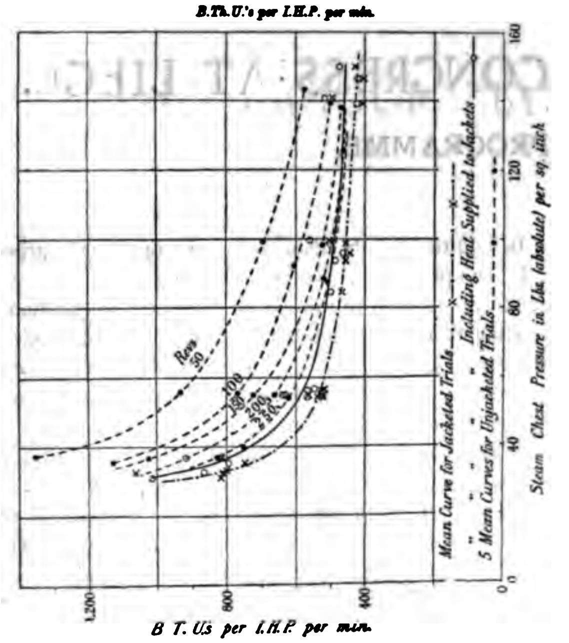
It is found that the leakage, under given conditions of pressure, is equal to a maximum of 20 per cent. of the total steam used down to a minimum of 4 per cent. It is therefore in no case negligible.

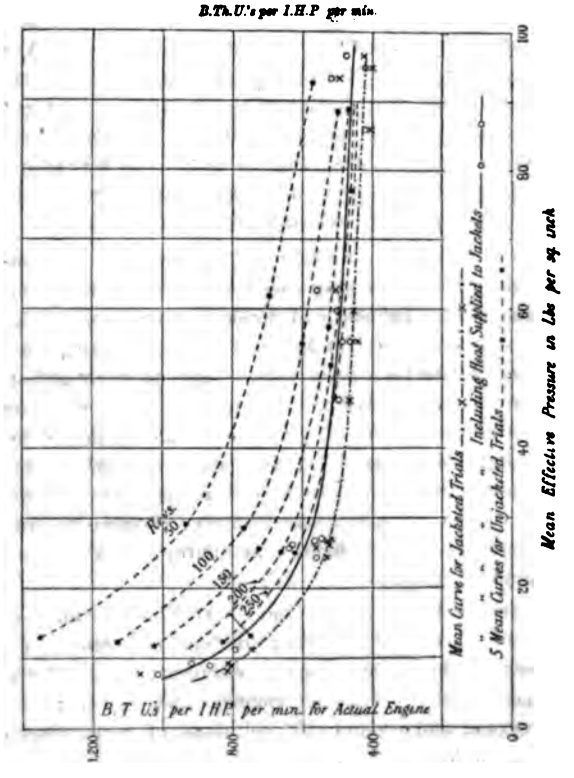
The leakage through the piston was measured by blocking the port at one end of the cylinder and running the engine single-acting. Cards of the working and blocked ends were also taken. It was found that the piston leak was independent of revolutions per minute, and was proportionate to the admission pressure and area of indicator diagram on the working side of the piston. The piston leak was found at its worst to be less than 2 per cent. of the steam consumption of the engine.

SOME RESULTS OF THE EXPERIMENTS.

It has been shown that for an unjacketed engine with a given ratio of expansion, initial condensation, expressed as a percentage of the steam in the cylinder, diminishes with increase of initial temperature, while the total condensation per stroke increases with such temperature increase. This, though suggested by Messrs. Callendar and Nicholson's researches, has never previously been demonstrated with clearness, as if leakage is not allowed for, the results are obscured and even reversed, and the conclusions arrived at without leakage allowance are therefore unreliable.

Also it appears from the results here obtained that the re-evaporation for a given ratio of expansion is as great and sometimes greater without jackets than with them. This shows very clearly that the regenerative action of the cylinder walls with a given ratio of expansion is largely independent of their mean





FIGS. 3 AND 4. RESULTANT CURVES SHOWING TEMPERATURE AND PRESSURE AT WHICH JACKETS CEASE TO BE ECONOMICAL.

temperature. No quantitative analysis of re-evaporation is possible where leakage is not taken into account, as without the necessary allowance results would be largely illusory.

Further, it is possible from the results obtained to show the temperature when for any speed of revolution with a given rate of expansion the jackets will here become unnecessary or wasteful. If the heat units per i.h.p. per minute required by the unjacketed engine for each speed of the series be plotted either on an initial pressure or a mean effective pressure base, the points for each speed will be found to lie on four curves, which become closer and closer to one another as the speed increases, and all converge to a point as pressure or temperature increases. If the heat consumption for the jacketed series be likewise plotted, it will be found that the points for the different speeds at each pressure lie irregularly round a point, their exact position being determined by the accidentally slight variations of the conditions of each trial. A fair curve through the means of these points will lie below the corresponding curves for the unjacketed trials, but if the heat absorbed in the jackets be included the resultant curve cuts the unjacketed curves at points which for each speed indicate the temperature and pressure at which the jackets cease to be economical. Such curves are shown in figs. 3 and 4. The resultant mean for the jacketed trials, cuts both the 250 and the 200 revolution unjacketed curves within the temperatures and pressures included within the scope of the present experiments, and the temperatures and pressures where the 150, 100, and even the 50 revolution curves would cut, can very closely be predicted. As far as the author is aware, this is the first time when an exact determination for a given engine and ratio of expansion of this point has been diagramatically shown.

The British Science Guild has appointed the following officers: Sir Norman Lockyer, president; Lord Avebury, hon. treasurer; Lady Lockyer, hon. assistant treasurer, and Mr. C. Cuthbertson, hon. secretary.

Mr. Arthur Peckett, of Bristol, has joined Mr. Herbert W. Umney, A.M.I.E.E., M.I.Mech.E., Assoc.M.Inst.C.E., in partnership at 46, King William Street, E.C., where the firm will carry on the business of civil, mechanical and electrical engineers, merchants and agents. They will also represent Messrs. Isaac Storey and Sons, of Manchester; The Sunderland Forge and Engineering Co.; Messrs. Rubery and Co., of Darlaston; Messrs. Pollock, Whyte and Waddel, of Johnstone, N.B.; and Messrs. J. and O. G. Pierson, of Paris.

THE INTERNATIONAL CONGRESS AT LIEGE.

PROVISIONAL PROGRAMME.

AS already announced, an International Congress of Mining, Metallurgy, Mechanics and Applied Geology will be held in connection with the Liége Universal Exhibition, from June 26th to July 1st.

The Council of the Congress Organising Committee comprises the following: President, M. Jules Magery, Past President of the Liége Engineers' Association; Vice-Presidents: M. Alfred Habets, Professor of Mine Working and of Industrial and Commercial Geography at the Liége University, President of the Liége Engineers' Association, President of the Mining Section; M. Adolphe Greiner, General Manager of the Société Cockerill, Seraing, President of the Metallurgy Section; M. Herman Hubert, Professor of Applied Mechanics and of Industrial Physics at the Liége University, President of the Mechanical Section; M. Max Lohest, Professor of Geology at the Liége University, President of the Applied Geology Section. General Secretary, M. Henri Dechamps, Professor of Industrial Architecture and Machine Construction at the Liége University. Assistant General Secretary, M. Paul Habets, Manager of the Espérance and Bonne-Fortune Colliery, Professor of Mine Working at the Brussels University. Secretary-Treasurer, M. J. Libert, Ingénieur-en-chef Directeur des Mines, Liége. Secretaries: M. René Henry, Engineer at the Hasard Colliery, Secretary of the Mining Section; M. Constant Renson, technical Director at the Angleur Steelworks, Secretary of the Metallurgy Section; M. Georges Duchesne, Engineer, Liége, Secretary of the Mechanical Section; M. René d'Andrimont, Secretary of the Liége Engineers' Association, Secretary of the Applied Geology Section.

Members of the Congress comprise: (1) Donors of at least a hundred francs (£4); and (2) Subscribers of twenty-five francs (£1). Donor members receive all the publications of the Congress. Subscriber members must enter their names for the section of which they desire to receive the publications. The twenty-five francs (£1) subscription only gives right to the publications of a single section; but the member's name may be entered in another section for an additional subscription of five francs (4s), which will give right to receive the publications of that section.

In addition to the inaugural meeting, the Congress will comprise: 1. General meetings. 2. Section meetings, devoted to the special discussion of questions relating to mining, metallurgy, mechanics and applied geology. 3. Lectures. 4. Visits to the Exhibition, to various scientific or industrial establishments and applied geology excursions.

A summary of the provisional programmes of the sections is given below. The complete text of the questions set down for discussion, the regulations of the Congress, and the complete list of the members of the organising committee, may be obtained on application to the general secretary, 16, Quai de l'Université, Liége.

I.—Mining Section. (1) Sinking deep shafts through sterile rocks; (2) Winding engines and plant; (3) Modern pumping engines; (4) Air-compressors; (5) Recent improvements in timbering and gobbing; (6) Shifting of the measures consequent on coal working; surface damage; (7) Mechanical preparation of ores and coals; (8) Firedamp; (9) Conditions to be satisfied by electric mine plant; (10) Unification of official mineral statistics.

II.—Metallurgy Section.—(1) Utilisation of non-caking coals for making coke; (2) Study of the blast-furnace; (3) Influence of foreign substances on pig-irons and steels; (4) Methods for intercepting dust from blast-furnace gases with a view to their utilisation; (5) Slag bricks and cements; (6) Utilisation of poor gases with a view to producing power for driving roll-trains; (7) New methods for making open-hearth steel; (8) Special steels; (9) Forging by the press and steam-hammer; hardening and annealing; (10) Electro-metallurgy; (11) Metallography.

III.—Mechanics Section.—(1) Construction of engine parts; (2) Internal combustion motors; (3) Mechanical applications of electricity; (4) Turbo machines; (5) Steam engines and boilers; (6) Practical and economical conditions of motor-wagon construction and use.

IV.—Applied Geology Section.—(1) Tectonics of coal basins; (2) Sedimentary deposits; (3) Metalliferous lodes; (4) Hydrology.

THE LABOUR MARKET IN FEBRUARY.

BOARD OF TRADE returns just issued show that employment in February was better on the whole than in the previous month.

Employment in coal-mining during the month was fair generally, and showed some improvement, on the whole, as compared with a year ago. At collieries employing 534,664 workpeople, the pits worked on an average 5·31 days per week during the four weeks ended February 25th, compared with 4·95 in January, 1905, and 5·19 in February, 1904. Employment, however, in January, 1905, was affected by holidays to some extent.

In iron mining employment also continued good and was better than a year ago. At the 122 mines and open works covered by the returns received from employers, the average number of days worked per week during the four weeks ended February 25th was 5·90 as compared with 5·41 in January, and 5·79 in February, 1904. The number for January, however, is reduced by Christmas and New Year holidays.

Employment in the pig iron industry continued to improve during February and was considerably better than a year ago. Returns relating to the works of 108 ironmasters show that 311 furnaces, employing about 22,140 workpeople, were in blast at the end of February, 1905, or five more than at the end of January, and ten more than at the end of February, 1904.

Shipbuilding employment, though still dull generally, continued to improve and was better than a month ago. The percentage of trade union members unemployed at the end of February was 11·5, as compared with 12·4 at the end of January, 1905, and 12·6 at the end of February, 1904.

At iron and steel works employment was considerably better than a year ago. Returns relating to 202 works, employing 88,173 workpeople, show that the volume of employment in the week ended February 25th, 1905, was 4·6 per cent. greater than in the corresponding week of February, 1904. Taking the numbers employed according to the departments specified in the following table, it will be seen that there has been an increase in all branches, except in the Bessemer converting department, where a slight decrease is shown. The average number of shifts worked likewise shows an increase in all departments except one (founding) and is greatest in puddling forges, where it amounts to 5 per cent.:—

Department.	Numbers employed in week ended			Average Number of Shifts worked per man in week ended	
	Feb. 25th, 1905.	Feb. 27th, 1904.	Increase (+) or Decrease (−) in 1905.	Feb. 25th, 1905.	Feb. 27th, 1904.
Open-Hearth Melting Furnaces ...	7,777	7,631	+ 146	5·89	5·86
Bessemer Converters	2,238	2,318	− 80	5·04	4·95
Puddling Forges	9,527	9,487	+ 40	4·80	4·57
Rolling Mills	28,672	28,112	+ 560	5·23	5·16
Forging and Pressing	3,453	3,424	+ 29	5·49	5·42
Founding	9,279	9,145	+ 134	5·78	5·80
Other Departments	9,398	8,900	+ 498	5·81	5·72
Mechanics and General Labourers ...	17,829	16,458	+ 1,371	5·74	5·70
Total	88,173	85,475	+ 2,698	5·49	5·41

Employment in engineering trades, though still dull, was better than a month ago, and about the same on the whole as a year ago. The percentage of trade union members who were unemployed at the end of February was 6·4, as compared with 7·0 at the end of January, and 6·5 at the end of February, 1904. The percentages for the various districts are shown in detail in the following table:—

District.	No. of Members of Unions at end of Feb., 1905, included in the returns.*	Percentage returned as Unemployed at end of			Increase (+) or Decrease (−) in percentage unemployed for Feb., 1905, as compared with a	
		Feb., 1905.	Jan., 1905.	Feb., 1904.	Month ago.	Year ago.
North-East Coast	12,993	5·7	5·4	5·1	+ 0·3	+ 0·6
Manchester and Liverpool District	17,912	8·5	8·1	6·9	+ 0·4	+ 1·6
Oldham, Bolton, and Blackburn District	12,555	10·5	11·8	11·1	− 1·3	− 0·6
West Riding Towns	11,691	9·0	9·2	8·2	− 0·2	+ 0·8
Hull and Lincolnshire District	3,431	4·6	6·2	8·4	− 1·6	− 3·8
Birmingham, Wolverhampton, and Coventry District	6,363	4·0	4·7	4·3	− 0·7	− 0·3
Notts, Derby, and Leicester District	4,052	11·0	11·1	5·6	− 0·1	+ 5·4
London and Neighbouring District	12,024	4·6	4·4	4·6	+ 0·2	...
South Coast	4,090	3·1	2·2	2·1	+ 0·9	+ 1·0
South Wales and Bristol District	6,492	3·5	2·9	3·6	+ 0·6	− 0·1
Glasgow and District ...	13,949	7·3	8·5	9·3	− 1·2	− 2·0
East of Scotland	3,617	10·5	12·1	10·1	− 1·6	+ 0·4
Belfast and Dublin	3,453	9·8	13·2	8·1	− 3·4	+ 1·7
Other Districts	5,575	5·1	5·1	5·0	—	+ 0·1
United Kingdom (Including certain Unions for which district figures are not available)	143,934	6·4	7·0	6·5	− 0·6	− 0·1

FLAT-BOTTOMED RAILWAY RAILS.

STANDARD SPECIFICATION.

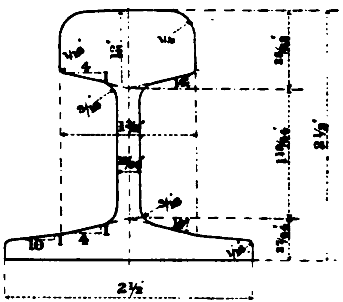
FROM Mr. Leslie S. Robertson, M.Inst.C.E., Secretary, we have received the Engineering Standards Committee's standard specification and sections of flat-bottomed railway rails. The thanks of the Committee are tendered to the members of the Railway Engineers' Association for their co-operation in the preparation of this report, and in particular to Mr. James C. Inglis and Mr. G. L. Eyles for the various series of standard flat-bottomed rails.

The following is a list of members of the Committee on Rails: Sir John Wolfe Barry, K.C.B., Chairman; Mr. F. R. Upcott, C.S.I., representing the India Office; Sir W. Shelford, K.C.M.G., and Mr. G. L. Eyles, C.M.G., representing the Crown Agents for the Colonies; Mr. Charles F. Wike (City Surveyor, Sheffield) and Mr. W. Harpur (Borough Engineer, Cardiff), nominated by the Incorporated Association of Municipal and County Engineers; Mr. Stephen Sellon nominated by the Light Railways and Tramways Association; Mr. J. Wilson (G.E.R.) and Mr. W. B. Worthington (L and Y.R.), nominated by the Railway Engineers' Association; Messrs. J. A. F. Aspinall (L. and Y.R.), W. Evans, Brodie Henderson, and James C. Inglis (G.W.R.); Dr. A. B. W. Kennedy; Messrs. D. A. Matheson (C.R.), E. P. Martin, E. Richards, E. Windsor Richards, A. Ross (G.N.R.), W. Howard Smith, E. B. Thornhill (L. and N.W.R.), and J. M. While.

The Sub-Committee on Railway Rails was as follows. Mr. James C. Inglis, Chairman; Messrs. F. R. Upcott, C.S.I.; G. L. Eyles, C.M.G.; J. Wilson (G.E.R.), W. B. Worthington (L. and Y.R.), J. A. F. Aspinall (L and Y.R.), W. Evans, Brodie Henderson, E. Windsor Richards, A. Ross (G.N.R.), E. B. Thornhill (L. and N.W.R.), and J. M. While.

The steel for the rails is to be of the best quality made by the Bessemer, Siemens-Martin or other process, to be approved by the engineer (or by the purchaser). The rails are to conform to the following limits:—

Carbon	from	0·35 to 0·5	per cent.
Manganese	„	0·7 to 1·0	„
Silicon	not to exceed	0·10	„
Phosphorus	„ „	·07	„
Sulphur	„ „	·07	„



"B.S." Section No. 20.
20 lbs. per yard

TABLE OF GENERAL DIMENSIONS OF "B.S." RAILS.

No. of "B.S." Section.	Height of Rail.	Width of Head.	Nominal Weight of Rail.
	inches.	inches.	lbs. per yard.
20	2½	1¼	20
25	2¾	1⅜	25
30	3	1½	30
35	3¼	1⅝	35
40	3½	1¾	40
45	3¾	1 31/32	45
50	3 15/16	2 1/16	50
55	4⅛	2 5/32	55
60	4 5/16	2¼	60
65	4 7/16	2 5/16	65
70	4⅝	2⅜	70
75	4 13/16	2 7/16	75
80	5	2½	80
85	5 3/16	2 9/16	85
90	5⅜	2⅝	90
95	5 9/16	2 11/16	95
100	5¾	2¾	100

Falling Weight Test.

Weight of Rails per yard.	Weight of Tup.	Centres of Bearings.	Drop.
lbs.	cwts.	feet.	feet.
20	5	3	8
25	5	3	9
30	10	3	10
35	10	3	12½
40	10	3	15
45	15	3	15
50	15	3	15
55	15	3	17½
60	20	3	20
65	20	3	20
70	20	3½	20
75	20	3½	20
80	20	3½	22
85	20	3½	24
90	20	3½	26
95	20	3½	28
100	20	3½	30

Each rail is to be made from an ingot not less than 12 inches square at the smaller end and 14 inches square at the larger end, which must be cogged down into blooms, and have sufficient crop then sheared from each end to ensure soundness. A rolling margin of ½ per cent. under to ½ per cent. above the specified weight will be permitted, but the contract weight only will be paid for.

The following impact test is provided: From each cast a piece of rail shall be selected by the inspector and stamped with his mark and the number of the cast. From this a piece 5 feet long shall be cut, which shall be placed in a horizontal position, with the head uppermost, on two iron or steel supports resting on solid foundations, the upper surfaces of the supports being curved to a radius of 3 inches: this sample may be taken from a crop end. The test shall comprise one blow, delivered midway between the bearings, from a falling weight or tup, the striking face of which shall be curved to a radius of not more than 5 inches. The weight of tup, span of test piece between centres of bearings, and height of drop for the various sections of rails being as tabulated on page 644. In addition to the above test the inspector shall select one finished rail from every 200 offered, and a piece 5 feet in length cut from this rail shall be similarly tested as specified above.

Should any rail show fracture under the falling weight test, the entire cast from which it was selected shall be rejected.

The following tensile test is provided for: From each 100 tons of rails the manufacturer shall (if required by the representative of the engineer or of the purchaser) cut a test piece from any rail selected as a sample rail; such test piece to be stamped to correspond with the sample rail. It shall then be placed in a testing machine of approved pattern, and shall show an ultimate tensile strength equivalent to not less than 40 tons per square inch nor more than 48 tons per square inch, with an elongation of not less than 15 per cent. upon the standard test pieces. Should the test piece fail to fulfil these conditions, the representative of the Engineer (or of the purchaser) may require the manufacturer to test two other rails from the same cast in the same manner, and the acceptance or rejection of the cast shall be decided by the result of the three tests, so that if two of the three rails selected fail to comply with the test the entire cast will be rejected.

THE OPENING OF NEW PREMISES IN HOLBORN BY MESSRS. MABIE, TODD AND BARD.

THE opening of the new home of the "Swan" Fountain Pen by Messrs. Mabie, Todd and Bard, was celebrated on the 16th inst., at the Holborn Restaurant by an informal, but very enjoyable lunch. The numerous guests were cordially received by Mr. Alfred Watts, the duties of the chair being undertaken with much geniality by Mr. Walter Haddon. Messrs. Mabie, Todd and Bard may be said to have brought the fountain pen to London, and the fact that they are still pioneers, and are making more gold pens than any other firm in the world, is certainly eloquent. Moreover, the history of the firm's operations over here should be an instructive object lesson for firms who are introducing a new commodity. Their advertising was at first far from pretentious, but it was persistent, and it is significant that the firm now advertise in some 400 different journals.

They commenced with a small establishment in Cheapside, and extended their premises gradually with the growth of the business. When the superiority of the "Swan" Fountain Pen became sufficiently known larger premises were opened at 93, Cheapside. In 1893 a West-end branch was opened at 95 Regent Street, and by that time the business had attained considerable importance. It was found necessary to enlarge the Cheapside establishment, and branches were opened at Manchester, Paris and Chicago, the parent house in New York being also removed to larger premises, with a corresponding increase in the factory organisation. Now the old headquarters in London have proved to be entirely inadequate, and have been transferred to handsome new premises at 79–80, High Holborn, where callers can have the additional advantage of reading and writing rooms and the telephone service.

The luncheon, for which an excellent menu was provided, was followed by speeches contributed by the chairman, his partner, Mr. Smith, Mr. Alfred Watts, whose health was given with musical honours, Mr. Robert Barr, and others. At the special request of Mr. Mabie, from New York, the signatures of all who attended were inscribed upon copies of the menu, and a pleasant surprise was the gift to each guest of a souvenir fountain pen.

OPENINGS FOR TRADE ABROAD.

Italy.

A Bill has been introduced by the Minister of Public Works, to provide for the expenditure of about £1,600,000 on the purchase of rolling-stock and other materials for railways. The Bill contains a clause restricting the purchase of materials to native establishments, except in the case of those which are not manufactured in the country.

Belgium.

The Société Nationale des Chemine de Fer Vicinaux invite tenders for the construction of a railway between Ittre and Virginal, and the improvement of the main road between these districts, at the estimated cost of about £7,170, the adjudication to take place on March 29th : the construction of a section of the projected line from Poulseur to Trooz, at the estimated cost of about £3,905 the adjudication to take place on May 3rd. A deposit of £720 is required in the first case, and of £400 in the second, to qualify any tender.

Tenders in registered envelopes, addressed to "M. le Directeur Général, 14, Rue de la Science, Brussels," must be posted not later than the day previous to the date of adjudication.

Sweden.

The Registrar of the State Railway Administration, Stockholm, is prepared to receive tenders until 31st inst. for the supply of 3,250 metres of tram-rails with fish-plates, bolts, etc., four sets of junction rails, and two electric traverses.

British India.

The Madras Railway Company are prepared to receive, tenders until Monday, 27th inst., for the supply and delivery, free on board, of wrought iron and steel bars, sheets, plates and wire, copper and brass sheets, wire and rivets, zinc, tin, galvanised and lead sheets, pig-lead, files, wood screws, nails, chain, vices, picks, shovels, crowbars, hammers, wrenches, braces, augers, carpenter's tools, door bolts, locks, buckets, copying presses, lamp fittings, cutlery, general ironmongery, globes and gauge glasses, lenses, and fog signals, as per specifications to be seen at the Company's offices, 1, Broad Street Place, Finsbury Circus, E.C.

French India.

The sum of 4,923,000 francs was recently voted for various public works in the French Settlements. These comprise improvement of the water supply of Pondicherry and Chandernagore : restoration of dam at Poulearcoupam : improvement of shipping accommodation at Karikal : construction of a railway from Vridhachellam to Cuddalore : erection of a hospital at Karikal, and extension of the pier at Pondicherry.

China.

A body of influential merchants and others, of the Province of Kiangsi, have presented a petition to the Ministry of Commerce asking permission to form a provincial syndicate for the construction of a railway between Nanch'ang, the capital, and Kiukiang, the treaty port, of Kiangsi. The funds for the construction works are to be provided from the reserve and emergency funds of each district and sub-prefecture of the province, and money subscribed at will by wealthy landowners and merchants of Kiangsi.

Cape Colony.

A Board of Trade correspondent in Cape Town states that there is a good opening for steam rollers in Cape Colony. This is consequent on the steps which are being taken by the various Divisional Councils to improve the main trunk roads in all parts of the Colony. Steam rollers are already largely used for road-making purposes in Cape Town, and now that macadamised roads are being laid down more and more, it is certain, says the writer, that the demand for these implements will increase.

Transvaal.

Tenders are invited by the Municipal Council of Johannesburg for the undermentioned electric tramway and lighting materials, and for erection of same to Specification No. 13 of their consulting engineers, Messrs. Mordey and Dawbarn, of 82, Victoria Street, S.W. Consideration will be given to tenders for any one or more of the five following sections :—

(A) The supply of tramway poles and brackets ; (B) the supply of feeder pillars, controllers, insulators, and all overhead material ; (C) the supply of street arc lamps, glow lamp fittings, lanterns, ornamental lamp posts, automatic switches, etc. ; (D) the erection of the material included in Sections A, B, and C ; (E) the supply of a motor tower wagon.

Copies of the specifications may be seen at the consulting engineer's office, and may be obtained on payment of five guineas, returnable on receipt of a bona fide tender, which should be endorsed "Johannesburg Tender to Specification No. 13," and addressed to Messrs. Mordey and Dawbarn, in order to reach them not later than May 8th next.

POWER GAS.

BY F. H. BOWMAN.

THE improvements made during the last few years in internal combustion engines have given a great impetus to their use for all purposes, and specially for the generation of electricity for light and power distribution.

The utilisation of blast furnace gas is now becoming the rule rather than the exception, and in place of being burned under boilers, for the purpose of generating steam power, is being used in large gas engines after proper cooling and purification, so as to remove all dust. The use of natural gas, or gas derived from sources as above, can only, however, be made to a limited extent, as such gas is not available in the great majority of cases where large power and light distributing stations have to be put down.

This leads to a consideration of producer gas plants. Of these plants it is only necessary to mention the Wilson, Mond, Duff, Duff-Whitfield, and Dynamic Bituminous plant. It must be remembered that in all these cases it is not every kind of bituminous slack which can be used. With a good bituminous plant and recovery of residuals and a modern gas engine developing 1,000 b.h.p. on a full load, a b.h.p. can be produced at a cost of under 0·2d. per hour, including everything, and a kilowatt hour for 0·25d. per hour at the pole of the dynamo. With a pressure plant such as a Dowson, using anthracite or coke, a b.h.p. may be obtained, including everything for about 0.45d. per hour, and a kilowatt hour for 0·6d. per hour.

DYNAMIC GAS PRODUCER.

The Dynamic gas producer is claimed to be the most perfect of its type, and when suitable fuel is employed and the engine properly constructed in regard to the proportions of its valves and the compression of the gas before ignition, it is at present the most economical source of power which can be obtained. The composition of the gas is practically the same as produced in a pressure plant using non-bituminous fuel, but it is much more regular, and the calorific value can go as high at 155 b.t.u.; but its average value is about 150 b.t.u., being a mixture of producer and water gas.

The engine and producer, however, in this suction plant being exactly suitable to each other, the engine has absolute control—not only of the quantity, but also the quality, of the gas, and the regularity in the composition much exceeds that from any pressure plant. Analysis of the gas taken from a Dynamic gas producer, even when running on an irregular load, showed no variation exceeding from 148 to 155 b.t.u., and samples taken at regular intervals during many hours showed a regular average of about 42 per cent. of combustible matter. The first suction plant put down in this country to drive a public electric lighting plant was at the Suffolk Electricity Supply Company's station at Stowmarket, where the results were most satisfactory.

THE CAPACITY OF PRODUCERS.

These producers can be made to drive any power required, and for which gas engines can be made, and under suitable conditions more than one engine or a multi-cylinder engine can be driven from the same producer. Many are now working successfully in all parts of the country, driving every class of machinery from large textile mills where absolutely steady running is essential, down to heavy machinery in engineering works. They are also employed in public and private electric light and power stations, and the working and economy have never been exceeded.

The author has installed several plants in which two engines are running from the same producer with great success, even when there is a great disparity between the two in size. The table on page 648 is instructive.

The one disadvantage of a suction gas producer is that it cannot be worked on an absolutely light load for any length of time, because when no air or an insufficient quantity of air is drawn into the producer the temperature of the fuel falls, and so at last it is reduced to the point that good gas is not produced. This is specially the case in small plants where the volume of incandescent fuel is small. The limit of satisfactory working on light loads seems to be about one-fifth of the total load. A 50-b.h.p. engine will not work for long under 10 b.h.p. In large units where there is a greater reserve of heat the elasticity is greater, and no difficulty is experienced in taking off or putting on a large proportion of the load without any variation in the running.

In making comparison between the advantages of a power plant with suction producers and any other form, such as steam or water power, the limitations already named must be taken into account. For single units above 2,000 b.h.p. no advantage can at present be gained over steam or water power where bituminous fuel is cheap or the water supply abundant, but the advantage is that even with units from 100 b.h.p. up to 500 b.h.p. as great economy can be obtained as with the largest steam or water plant under the most favourable conditions, and thus even small industries can obtain power under the "most favoured nations clause" for commercial competition.

SOME COMPARATIVE FIGURES.

If a comparison is made between a gas engine using town's gas, and the same engine with suction producer gas, the results are very remarkable and differ, of course, with the cost of the town's gas and the anthracite. A plant recently put down in Yorkshire at the works of the Weldrivet Boiler and Motor Company, Ltd., Halifax, drives a 60-b.h.p. Campbell gas engine, and the power, which is on the average about 30 to 40 b.h.p., is distributed electrically. The cost per week of 54 hours with town's gas at 2s. 6d. per 1,000 cubic feet was about £3 18s. per week. Since the suction plant has been put in the cost of the anthracite coal has not exceeded 14s. per week, or rather less than one-tenth of a penny per b.h.p. Compared with using town's gas we may say roughly the saving per 1,000 cubic feet ranges from 50 to 84 per cent., according to the price charged for gas.

These figures give the saving in fuel alone. This percentage is borne out by the experience of many larger plants.

The use of such a plant as against any small steam engine and boiler of the same size, which would probably be a vertical boiler and engine combined, offers a very great advantage, since any engineer who has had experience of such a plant knows that a continuance of 12 b.h.p. could not, including everything as above, be obtained with such a plant at three times this amount.

Treating such a small plant as the generating station for the electric light it will with 12 h.b.p. supply 120 16 candle-power incandescent lamps, and to get the cost per unit of electricity, there must be added the interest at 10 per cent. on the cost of a suitable dynamo, which, with strap to drive, fixing and accessories, may be taken to cost £80. The interest at 10 per cent. will be £8 per annum, and we have, therefore, to add to the figure 0·51d. per b.h.p.

$$\frac{8 \times 20 \times 12}{3{,}000 \times 12} = \frac{1{,}920}{36{,}000} = 0{\cdot}053 \text{ pence,}$$

which brings the cost up to 0·563d. Adding one-quarter to this we get the cost per b.t.u. per hour = 0·704d. per hour, which is a little less than ¾d. per b.t.u.

The continuous improvements which are being made in gas engines, however, seem to indicate that before long, still larger units may be advantageously employed, and while the efficiency of the gas engine is considerably higher than that of the steam engine at present, the possibilities of future improvement are much greater.

Figures show that the gas engine is at present, even compared with the very best steam engines, 5·4 per cent. more efficient, and if both were made absolutely

Test of Dynamic Gas Producer for Coal Consumption.

Made by J. WHITWORTH, Engineer.

Name, Size, and Speed of Engine, and Description of Brake.	Condition of Producer before and after test	Starting up Producer. TIME.	COAL CONSUMPTION. Best Welsh Anthracite Nuts used.
Crossley Brothers' "Otto" 8½ inch Cylinder. 15 .. Stroke 250 revolutions per minute. Brake, 44 in. diameter to centre of rope. Weight of Cast-Iron Pan .. 101¾ lbs. Weight in Pan . .. 42 143¾ Spring Balance showed .. 8 (W.— w) = 135¾ Explosions counted every 30 minutes. Varied from 106 to 110 out of poss. 125. Brake Horse Power .. .. 11·5 Indicated " .. .. 12·5	Producer working the day before shut down at 5 p.m Producer half full of fuel Ashpit cleaned out before starting test **AFTER TEST** After test contents of Ashpit were riddled out through a ¼-inch mesh riddle. Unconsumed large coal 13lbs. " small coal 10lbs. Ash, 4 % .. .. 3 lbs Fuel in Producer left at same level as before the test	Started to blow up Producer with hand fan .. 11-0 a.m Got Gas .. .. 11-5 " Engine Started .. 11-6 " Fan Stopped .. 11-6 " Load on Brake .. 11-7 " Engine up to speed 11-11 " Put in first charge of fuel .. 11-11 " Put in last charge .. 3-35 p.m. Engine shut down .. 4-10 " Total Time of Test . 5 hours	Total Coal put into Producer 74 lbs. Ash, 4 % .. .. 3 lbs. 71 lbs. Unconsu large coal 13 " small coal 10 23 Total Coal used .. 48 lbs. $\frac{48}{5}$ = 9·6 lbs. coal per hour. $\frac{9{\cdot}6}{11{\cdot}5}$ = 0·835 lbs. per B.H.P. $\frac{9{\cdot}6}{12{\cdot}5}$ = 0·768 lbs. per I.H.P. **COST OF RUNNING.** Coal 32/- per ton. 7th of a penny per B.H.P. hour. 8th " " I.H.P. " THIS IS FOR FUEL ONLY.

REMARKS.—The Producer worked perfectly constant as seen by the Engine's constant speed and very regular explosions. There is no smell or dirt. Requires very little attention—one man for Producer and Engine. Speed was counted and diagrams taken every thirty minutes perfect the gas engine would be 46 per cent. more efficient than the steam engine.

On the Continent very large suction plants have recently been put down for light and power purposes.[*]

ELECTRIC LIFTING MACHINERY.

At the last meeting of the Birmingham and District Electric Club, Mr. Edward C. R. Marks read a paper with the above title, of which the following is an abstract :—

The most suitable form of electric energy is continuous current at 220 to 500 volts. This is superior to alternating current on account of the greater starting torque and acceleration given by the former. The operations of a crane involve a rapid succession of startings and stoppings ; continuous running occupies an unimportant fraction of the time, and loads are very variable. Alternating current motors while efficient at full loads, can have a strong starting torque only at the expense of efficiency. Continuous current on the other hand admits of easier regulation of motors, is cheaper than wiring, and can be stored in batteries to equalise a variable load. Series-wound motors, which automatically run faster with lighter loads, should be used if they are coupled permanently to the gearing. They should withstand 100 per cent. overloading for short periods, and much higher loads momentarily without damage ; which conditions are fulfilled by the ordinary tramway type.

Where motors run continuously, with clutch connections to the gearing, they should be shunt-wound. The proper speeds for a crane depend on the purpose for which it is intended. The ideal condition is rapid acceleration, uniform motion at high speed, and quick slowing down. Rapid acceleration can be obtained by employing series-wound motors, if permanently coupled or by the inertia of a continuously-running motor, if working through clutches.

On the question of voltage for electric overhead travelling cranes, a well-known American firm of large experience thus express themselves : 240 to 250 volts at the generator, with not less than 220 volts at the motors, has become practically the standard for crane service. The expense of conductors of suitable size to economically carry the necessary current is not excessive, and the tendency to establish grounds and short circuits at the various connections and insulation, because of excessive dust and moisture, is very much less than where higher voltage is used. The use of 110 volts for cranes of small size is not seriously objectionable, but the use of 500 or 600 volts, especially in foundries and steel plants where dust, moisture, and metallic oxides soon cover many parts of the crane, calls for constant self-regulation of speed.

BRAKES.

The brake equipment of a crane presents greater difficulties than the lifting equipment. If the brake does not properly take care of or control the load after the lifting effort ceases, disaster follows. As an American writer has well put it : "There is no trouble in getting the load to go up, as this is only a matter of gearing and power. The real test of fitness comes when the load has to go down, and go with some show of regard for the proper landing place." In a well-designed crane, fully 75 per cent. of the work represented by the load descending under brake control, is converted into heat. Such heat generated at the brake must be thrown off fast enough to prevent an excessive rise in temperature, such as would damage the friction surfaces, or, what is far worse, set up internal stresses likely to produce fracture. A sudden fracture in a rapidly revolving brake-wheel may result in consequences akin to those of a boiler explosion.

INSTITUTION OF MECHANICAL ENGINEERS.

A special meeting has been called for to-night, when Professor Capper's paper, "First Report to the Steam Engine Research Committee," read at last Friday's meeting, will be further discussed.

The Council draw the attention of all classes of members to By-law No. 7, which reads as follows : "The abbreviated distinctive titles for indicating the connection with the Institution of Members, Associate Members, Graduates, Associates, or Honorary Life Members thereof, shall be the following :—for Members, M.I.Mech, E. ; for Associate Members, A.M.I.Mech.E. ; for Graduates, G.I.Mech.E. ; for Associates, A.I.Mech,E ; for Honorary Life Members, Hon.M.I.Mech.E." Other abbreviations are not recognised as appertaining to this Institution.

At the Ordinary Meeting of the Institution of Civil Engineers on 7th March, Sir Guilford L. Molesworth, K.C.I.E., President in the Chair, it was announced that twelve associate members had been transferred to the class of Members, viz., Messrs. C. Brownridge, H. Deans, B.A. (Cantab.) ; W. Emmott, A. Fidler, A. P. Griffiths, B.Sc. (Paris) ; H. Japp, I. P. Marshall, H. F. Peet, E. van Putten, J. R. Settle, R. C. Sikes, B.E., B. A. (Royal), F. Wood.

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[*] Abstract of paper read before Leeds Local Section, Institution of Electrical Engineers.

INSTITUTION OF MINING AND METALLURGY.

THE annual general meeting was held last week at Burlington House, Piccadilly, W., when the newly elected President, Mr. Wm. Frecheville, delivered his address.

The President, in his opening remarks, dealt with new sources of mineral wealth within the British Empire. He referred to the possibilities of important finds in the Himalayan country and in Australia, pointing out that the fact that the fringe of known and occupied country surrounding Australia, from Queensland, through New South Wales, Victoria, and South Australia, to West Australia, was not only mineral-bearing, but richly so, indicated that the probabilities of further discoveries being made towards the interior were very great.

Addressing himself to new developments in mining appliances the President referred to the working of deep alluvial ground for gold by means of so-called pump dredges. Improvements had been made in this direction, and several large plants were now working successfully. One he saw recently was on Adelong Creek, in New South Wales, where the gravels filling the valley of the creek are about 40 ft. deep, and the hard and uneven nature of the bed rock (granite) was such that bucket dredges, which work considerably cheaper than pump dredges, would leave a large portion of the gold behind. The plant appeared to be working about an acre per month to a depth of 40ft., at a cost of about 4½d. per cubic yard. The conditions which had made the plant a success, in comparison with early failures of similar plant in the same locality, were large power and large, specially designed, centrifugal pumps with removable linings.

COMPOUND CENTRIFUGAL PUMPS.

Another new development was the use of compound centrifugal pumps for high lifts. A large plant of that kind, for pumping about 1,000 gallons per minute from a depth of 1,450 feet, was put in a few years ago by a French company owning the important silver-lead mines at Horcajo, Province of Ciudad Real, Spain. The total height of 1,450 feet was accomplished in four lifts, each lift being done by a quadruple centrifugal pump, driven by a three-phase motor. These quadruple pumps consisted of four pump-discs on the same shaft and in the same housing or case, each disc being calculated to lift about 125 feet, and delivering its water to the next, which in its turn imparted an additional and equal impulse or push. By this system it was found possible to raise water to heights which a few years ago would have been considered impossible for centrifugal pumps.

It was stated that water was being raised somewhere about 1,200 feet in one lift, by these means, in a colliery in Germany.

The ball-bearing thrust-blocks of the pump appeared to be the principal cause of anxiety, but in the more recently constructed pumps a better balance had been effected. As regarded efficiency, the makers guaranteed that 68 per cent. of the power given out by the motor when running at its proper speed should appear in water pumped.

According to the data supplied at Horcajo the coal consumed per water horse-power hour amounted to about 2·2 kilos, say, 4·8 lb., equivalent, with the quality of coal used, to about 34 lb. of steam, and the whole plant, at surface and underground, was said to have an overall efficiency of about 50 per cent., as measured by the water pumped. In a recent tender for such plant a well-known firm, using Parsons' turbines in the generating station, offered to guarantee a coal consumption of 3·66 lb. per water horse-power hour, and stated that if gas engines were used, the coal consumption would be about 2·7 lb. for the same work.

A COMPARISON WITH CORNISH PUMPS.

In order to compare these figures with the results which were being obtained by large Cornish pumping plants, it should be mentioned that the ordinary Cornish engine was stated by authorities on the subject to use from 3½ to 3¾ lb. of good coal per water horse-power hour. Somewhat higher efficiency than this had at times been claimed, and the more recent compound engines, using high pressure steam, were stated to be only using from 2½ to 3 lb. of coal. A weak point in connection with these high-lift centrifugal pumps was that they had not yet been used successfully for sinking. The trouble appeared to be that they lost the water when going "in fork." Efforts were being made to overcome that difficulty.

Another feature which might be somewhat of a drawback, under certain circumstances, was that, like all centrifugal pumps, to get a good efficiency, they must be driven at a certain speed, and if this speed was departed from the efficiency fell off very rapidly.

Regarding the information usually given to shareholders in a mining company it had come to be recognised by mining companies that they were expected to give shareholders periodically a correct statement of the ore " in sight," but, as regarded the appearance of the bottom of the mine and the future prospects, there was often room for very much more candour. Too frequently the first intimation a shareholder got that something was wrong with his mine, was given by the falling market value of the shares. It might be stated broadly that a manager of a mine in his periodical letters, gave free expression to his hopes and fears, and that any important change for better or for worse was, as a rule, foreshadowed a long time before it happened.

Shareholders ought to have that information, which was obtained at their expense, and would be of much use in aiding them to form a just estimate of the value of their property.

Reviewing the objects and aims of the Institution and what had been achieved, Mr. Frecheville said that one important advance in the educational question, which had been made during the year, was the establishment of post-graduate scholarships at the Royal School of Mines, entitling the holders to go through a practical training at mines. It was to be sincerely hoped that the practical training would be worked on such lines as to prove a great success.

INSTITUTION OF ELECTRICAL ENGINEERS.

The members of the Manchester section of the Institution of Electrical Engineers held their annual dinner at the Midland Hotel. Mr. C. D. Taite, president of the section, was in the chair and among the guests were the Mayor of Salford (Mr. Alderman Stephens), Mr. S. L. Pearce, Mr. W. M. Mordey, Mr. H. A. Earle, Dr. Edward Hopkinson, Mr. F. E. Priest, Mr. A. Saxon (president of the Manchester Association of Engineers), Mr. J. S. Raworth, and Mr. T. L. Miller. The principal toast, "The Institution of Electrical Engineers," was proposed by Mr. H. A. Earle, and acknowledged by Mr. W. M. Mordey, who spoke of the rapid growth of the organisation (which was originally an offshoot of the Association of Engineers), and mentioned that there are now 5,700 members). Connected with the Institution are also six local sections (the greatest of which is Manchester), as well as sections at Capetown and Calcutta.

DEVELOPMENT OF THE TORPEDO-BOAT DESTROYER.

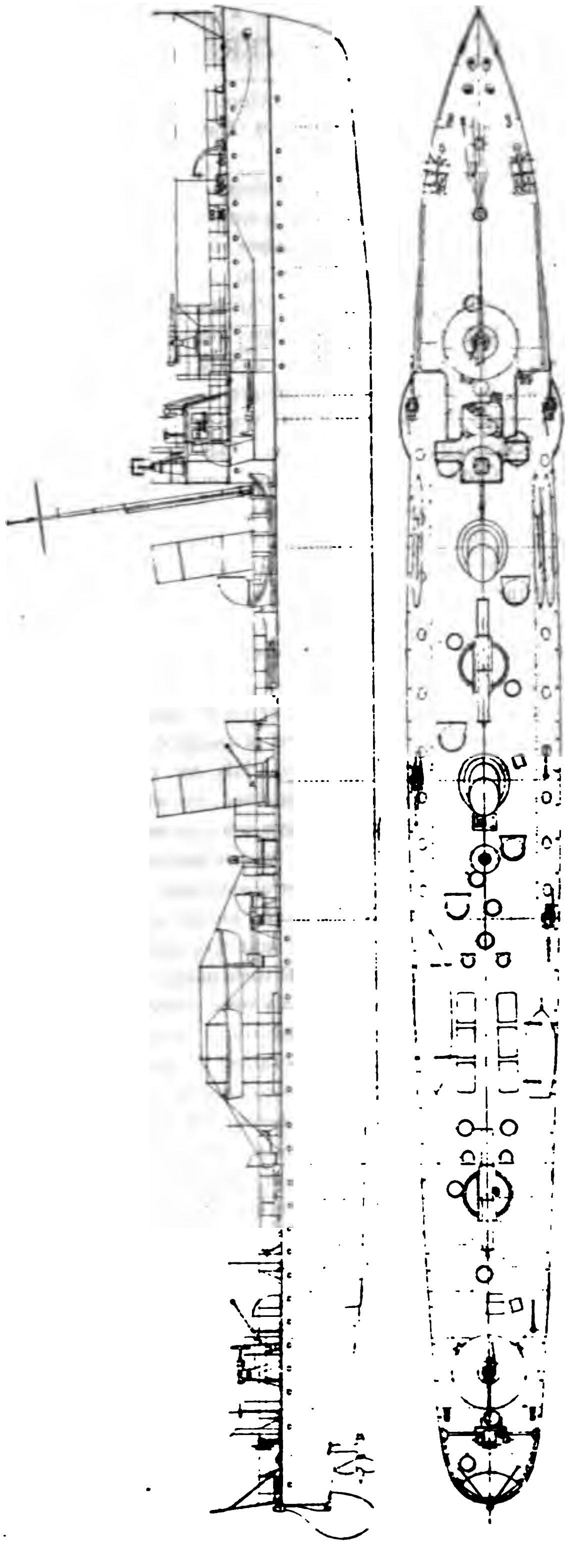
A paper on this subject was read before the Institute of Marine Engineers by Mr. W. J. Harding, R.N. The following is an abstract :—

The precursor of the destroyer class was evolved about 1884. Practically these destroyers were given just double the power of the latest torpedo-boats in being. It is interesting perhaps to note, that the 27 knot destroyers were built of galvanised mild steel plates, with tensile strength 30 tons, the thickness of garboard strake 6½ lb.; sheer strake, 9 lb.; deck-plating, 6½ and 8½ lb. per square foot. Afterwards a harder and stronger steel was used, which was more difficult to manipulate. This increased the cost of building but permitted comparatively lighter scantlings, This latter steel was 40 tons tensile strength. Its riveting was much more difficult with the hard rivets used; they required more knocking down, and the riveting was not so comely and smooth.

These 27-knot destroyers were of various lengths from 180 to 190 ft. and horse-power varying from 3,700 to 4,800.

The experience gained in the 27-knot destroyers was of great use when faster ones of 30-knot speed were required. The terms of the trials for the 30-knot destroyers were very much amplified, for whereas in the former 27-knot destroyers there were no reserves of coal consumption, in these it was intended that 2½ lb. per i.h.p. per hour should be a standard. This was much less than the average of the former 27-knot destroyers. Messrs. Thornycroft and Co. obtained the first record for 30 knots in a British naval vessel. Two other destroyers of higher speeds were afterwards built, the *Albatross* by Thornycroft, and the *Express* by Laird. The former obtained a speed of 31½ knots with i.h.p. of 7,700. The 30-knot destroyers were followed by a reaction in favour of stronger vessels, now known as the *River* class. These vessels are of about 550 tons displacement, 200 to 230 ft. long, and h.p. 7,500. They are much more costly than the 30-knot destroyers, and though their speed of 25½ knots was obtained in deep water, the author is of opinion that, if the 30-knot destroyers had different propellers fitted they would outrace all the *Rivers* at war-service lading with a smaller coal bill.

The author suggests a coast volunteer corps could be established, largely composed of young marine engineers, for service in these vessels as coast defenders, and that in war, the whole of our coasts could be defended by torpedo-boats and destroyers, leaving the battleships to do their work for the high seas.



PLAN AND PROFILE OF THE TWIN-SCREW TORPEDO-BOAT DESTROYER H.M.S. "KENNET," One of the river type referred to on page 651. She was handed over to the Admiralty by the builders, Messrs. John I. Thornycroft and Co., Limited, on January 18th last.

CAGE SKELETON CONSTRUCTION.

A LARGE party of members of the Junior Institution of Engineers recently visited the new Ritz Hotel, Piccadilly, to inspect the "Cage Skeleton System of Constructional Engineering" at the invitation of Mr. J. P. Bishop, one of the joint architects.

The new Ritz Hotel affords the largest example of the type in this country. A skeleton of steel framework, capable of carrying the whole deadweight of the walls, floors and roof, in addition to the live loads and wind pressure, is being erected, and is at present nearly completed. The walls are supported on girders at the level of each floor of the building. They carry no loads, but simply serve as a protection from the weather and for decorative treatment. The total weight of the building, with the live loads, is carried on the steel columns. Generally, the columns rest upon cast-iron base plates, about three to four feet square, which in turn rest upon a grillage of steel beams imbedded in cement concrete of sufficient area to distribute the load over the ground with a minimum depth of foundation. Cantilever foundations have been adopted for some of the columns next the adjoining buildings, so as to retain the whole of the foundations within the site. Some of these foundations may be seen in the basement. The building is of fireproof construction throughout. The whole of the steel work will be encased in masonry or concrete. The floors and roofs are of concrete steel on the Columbian system. The floors are hollow so as to be sound proof, and the construction adopted permits of a flat ceiling throughout, without panels, so as to give apparent greater height to the rooms.

ELECTRICAL EXHIBITION.

AN exhibition of electrical apparatus, under the style of the Holborn and Finsbury Electrical Exhibition, is now open. It has been organised by the County of London Electric Supply Company, which has areas of supply in Finsbury, Holborn, Wandsworth, Camberwell, Southwark, and Bermondsey, with the desire to popularise the use of electricity and to afford consumers an opportunity of inspecting the latest developments in connection with electrical lighting and heating and the application of electricity for driving machinery. Over sixty firms have contributed exhibits.

Engineering at Oxford University.

AN important announcement has been made in connection with the University of Oxford, whereby diplomas in scientific, engineering and mining subjects will be granted under statute passed last year. The object of the diploma courses is to provide those members of the University who intend to become mining or other engineers, with a sound preliminary training which will enable them to be thoroughly prepared for the study of the more technical branches of their subjects elsewhere than Oxford. To meet the case of those who intend to become colliery engineers, arrangements have been made with the Home Office by which a special form of the diploma will be accepted in lieu of two of the five years' underground work required as a qualification for obtaining a certificate as colliery manager. A candidate for the diploma must be a member of the University, must have passed all the examinations required for the degree of B.A., must have followed a course of study approved by the Committee in scientific engineering and mining subjects during two years, is bound to pass certain examinations, and must have undergone a course of practical training approved by the committee during four months in a mine or in engineering works.

The courses of the several diploma-subjects will be under the general supervision of the following: (*a*) Mathematics for applied science, Professor A. E. H. Love, M.A., D.Sc., F.R.S.; (*d*) Engineering, principles and machine drawing, Rev. F. J. Jervis-Smith, M.A., F.R.S.; (*e*) Surveying, H. N. Dickson, M.A., D.Sc.; (*f*) Geology, Professor W. J. Sollas, M.A., Sc.D., F.R.S.; (*g*) Mineralogy, Professor H. A. Miers, M.A., D.Sc., F.R.S.; (*h*) Mining and Engineering hygiene and mine-ventilation, J. S. Haldane, M.A., M.D., F.R.S.; (*i*) Electricity, Professor J. S. E. Townsend, M.A., F.R.S., Wykeham Professor in Physics; (*j*) Assaying, H. B. Baker, M.A., D.Sc., F.R.S. In the subjects (*b*) Physics and Chemistry and (*c*) French and German Translation, responsibility for instruction is not undertaken by the committee.

The range of knowledge required in engineering principles and machine drawing is grouped under the following heads: Strength of materials; elements of hydraulics; thermodynamics, and machine design, including the design of electric motors and generators of electricity, and engineering drawing. In electricity the subjects are electro-magnetic induction, alternating currents, with applications to the action of dynamos and motors, ammeters, and voltmeters. The mining and engineering hygiene and mine ventilation group includes analysis of air, the measurement of air currents, compressed air, poisonous gases, dust, etc. In physics and chemistry the syllabus is that of the preliminary examinations in these subjects in the Honour School of Natural Science. In framing the regulations the Committee considered a knowledge of mathematics of a practical kind and of the elements of physics and chemistry an essential preliminary to the study of more technical engineering, and they have made these subjects, as well as such a knowledge of French and German as will be necessary to read technical books in those languages compulsory for all candidates seeking the diploma.

This is a noteworthy departure in the direction of making the University courses of a more practical character, and the experiment will be watched with very great interest. The inception of this engineering course owes a good deal to Professor H. A. Miers, and he is to be congratulated on the results of his labours in this connection. Examinations in the subjects for the diploma, except physics and chemistry, will be held annually at dates to be announced. Any further information may be obtained on application to the Secretary, Mr. H. L. Bowman, at the University Museum, Oxford.

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts.

CONTRACTS OPEN.

Last Day.

Grindleford and Rowsley.—Construction of the Grindleford to Rowsley section of the Derwent aqueduct, in the county of Derby, for the Derwent Valley Water Board. Mr. Edward Sandeman, Engineer, Bamford, Sheffield .. .. March 27

Hornsey. — Supply of cables, junction boxes, fuse boxes and meters. Mr. Norman Staniland, Electricity Works. Tottenham Lane, London, N. ... ... March 27

Marylebone.—Carrying out of certain installation work and alterations to existing consumers' installations in the Marylebone district for the Borough Council. Specification, etc., from the electricity offices, 11, Manchester Street, London, W. March 27

Keighley.—One Lancashire boiler, and one 300-k.w. direct-current steam dynamo, high-speed enclosed engine, for the Electricity Committee. Particulars from Mr. J. M. Smith, borough electricul engineer, Electricity Works, Keighley. Deposit, £1 1s. ... ... March 27

Great Yarmouth.—Supply and delivery of (Section 3) surface condenser, with steam-driven air and circulating pumps, for the Corporation. Messrs. Preece and Cardew, 8, Queen Anne's-gate, Westminster, S.W. March 29

Bolton.—Supply and erection of cooling tower and condensing apparatus in connection with power station, for the Electricity Committee. Mr. Arthur A. Day, borough electrical engineer, Spa Road, Bolton ... ... March 30

Manchester.—Supply and erection of a Livesey washer and a rotary washer scrubber, for the Gas Committee. Specification from Mr. C. Nickson, superintendent, Gas Department, Town Hall ... March 30

Bradford.—Supply, erection and setting to work of 2,500 kw. of motor generators, or rotary transformers for transforming, together with the necessary controlling gear. Electricity offices, Whitaker-buildings, Bradford. ... ... March 30

Shanghai.—The Shanghai Municipal Council invite tenders for the construction and operation of about 24 miles of electric tramways on the trolley system in the streets of the Settlement of Shanghai; alternative proposals are desired for the single-trolley and double-trolley lines. Council's agents, Messrs. John Pook and Co., 63, Leadenhall Street, London, E.C., and Messrs. Fearon Daniel and Co., 90, Wall Street, New York. ... . March 31

Last Day.

Newport (Mon.).—Construction of main outfall and branch sewers for the Western Valleys Sewerage Board. Particulars at offices of Mr. Baldwin-Latham, Parliament Mansions, Victoria Street, S.W.; Mr. Geo. Chatterton, 6, The Sanctuary, Westminster, S.W.; or Mr. T. S. Edwards, Clerk to the Board, Newport (Mon.) .. April 1

Rishworth (Yorks.)—Construction of a concrete service tank (56,000 gallons), on Rishworth Moor, including wood and slate roof, for the Rishworth Urban District Council Waterworks. Messrs. Richard Horsfall and Son, surveyors and architects, 22a, Commercial Street, Halifax April 1

Aberdeen.—Erection of new bridge of steel girders and masonry, for the Alford and Huntley District Committee. Mr. James Barron, Central Chambers, 216, Union-street, Aberdeen. ... ... April 3

Birmingham.—Supply, delivery, and erection of 200 electric tramway cars for the Tramways Committee. Mr. Alfred Baker, general manager, 254A, Corporation Street, Birmingham ... ... April 4

Glasgow.—Electric power generating and lighting plant for Clydebank Dock, for the Trustees of the Clyde Navigation. Mr. T. R. Mackenzie, general manager and secretary, 16, Robertson Street, Glasgow, or from Mr. Geo. H. Baxter, mechanical engineer ... ... April 10

COMING CONTRACTS.

Chiswick.—The District Council have decided to apply for sanction to a loan of £18,000 for sewage works.

Maidstone.—An inquiry has been held into the application of the Town Council for sanction to borrow a sum of £6,000 for the electrical undertaking.

Marylebone. — An estimate of expenditure amounting to £10,395 has been prepared for the supply of electricity distributor cables and connections.

Paignton.—An inquiry has been held into an application by the Urban District Council for sanction to a further loan of £41,000 to complete the Holne Moor waterworks scheme.

Luton.—Application is being made for sanction to a loan of £5,000 for electric lighting purposes.

Tarporley.—An inquiry has been held at Tarporley into an application for an order to authorise the construction of a light railway from Tarporley to the Cheshire Lines at Mouldersworth. The total length of the line will be over seven miles and the estimated cost £46,000.

Shrewsbury. — The Council have sanctioned an expenditure of £5,295 to carry out extensions at the electrical works.

Newport. — The Electricity and Tramways Committee has resolved to obtain sanction from the Local Government Board to borrow a sum to cover the cost, about £25,000, of extending the condensing plant at the electricity works, and a further sum for mains, extensions, etc.

Ossett.—The Town Council on Monday decided to have plans and estimates prepared for the erection of an electric light and power station in connection with the refuse destructor.

CONTRACTS CLOSED.

Sheerness.—Johnson and Phillips have been awarded a contract for two direct-current dynamos for the Sheerness Dockyard.

Durham.—The Brush Electrical Engineering Company, Ltd., has secured an order for eight 500 k.w. three-phase transformers, for the County of Durham Electric Power Distribution Company.

Tredegar.—Iron and steel manufactured by Whitehead and Co., of the Deighton Ironworks, Tredegar, have been accepted by the Admiralty and by the Crown Agents for the Colonies. This is the first time for several years that Tredegar iron and steel, at one time world-renowned, find a place on the Government list.

King's Lynn.—The Town Council has accepted the tender of the General Electric Company, Ltd., for a steam dynamo, condenser and pipes, for the electricity station, at £1,098.

London United Tramways.—J. G. White and Co., Ltd., have just booked an important contract with the London United Tramways to the tune of about £165,000. The work comprises two distinct sections. The first is in Kingston, Surbiton, Malden and Wimbledon districts. The total route length of this line is about 10¼ miles, and the length of single track is about 18¾ miles. The second section is in Hanwell and Brentford, the route length of these lines being about 2⅝ miles, and the length of single track 5⅛ miles. W. T. Henley's Telegraph Works Co. has secured the contract for cable work in connection with the above tramways extension. This includes about 30 miles of three-phase 11,000 volt e.h.t. cable, and about 45 miles of l.t. feeder, distributor and telephone cables, etc.

Burslem.—The Town Council have accepted the tenders of Grant and Son, for erection of electric lighting station, destructor buildings, etc., at £3,745.

Birmingham.—Messrs. the New Conveyor Company, Ltd., Birmingham, have secured a contract for supplying the Birmingham Corporation with coal and ash conveying plants.

West Ham.—We are informed that Mountain and Gibson, Elton Fold Works, Bury, have received an order through Messrs. the Brush Electrical Engineering Company, Ltd., for thirty-five of their improved M.G. double-deck trolley standards, with poles and heads complete, for the West Ham Corporation Tramways.

Manchester.—Bruce, Peebles, and Co., Ltd., have secured an order from the Manchester Corporation for three 500-kilowatt Peebles motor converters. They have also secured a contract from the Lancashire Electric Power Company to supply alternating current motors of 15 horse-power and above for one year, for their hire, purchase, and development department.

APPOINTMENTS VACANT.

Last Day.

Leeds.—A lecturer in civil and mechanical engineering is required at the University of Leeds, salary, £300 per annum; a lecturer in civil engineering is also required, £300 per annum, with liberty to take up outside consulting work... ... March 25

London County Council.—Two divisional inspectors (at £600 per annum, rising by annual increments of £25 to £800), one possessing special qualifications in mathematics and science and the second in technology, including electrical and mechanical engineering; also an inspector in wood and metal work at £400, rising to £500... ... ... April 1

APPOINTMENTS FILLED.

Larne.—Mr. William M'Conchie has been appointed manager to the Larne and Stranraer Steamship Committee (owned by Midland, London and North-Western, Caledonian, and Great Southern and Western Railway Companies).

Midland Railway. — We understand that Mr W. B. Worthington, for the last eight years chief engineer of the Lancashire and Yorkshire Railway, has accepted the post of engineer-in-chief of the Midland Railway, rendered vacant by the lamented death of Mr. J. Allen McDonald.

Battersea.—Mr. W. A. Kemm has been appointed chief electrical engineer to the Battersea Borough Council. Mr. Kemm was formerly at St. Pancras, and later at Canterbury.

Swindon.—Mr. Medcalf has been appointed traffic manager of the Swindon Corporation's electric tramways at a salary of £150 per annum.

Southend.—Mr. J. Mitton, late mains superintendent at Southend-on-Sea, has been appointed chief assistant electrical engineer at that place.

Glasgow.—Mr. R. B. Mitchell has been appointed superintendent of mains to the Glasgow Corporation Electricity department, at £250 per annum.

Perth.—Mr. John Lambert, burgh electrical engineer at Perth, has been appointed also manager of the tramways, and his salary is to be increased from £275 to £350 per annum.

Carlisle.—Mr. William Dundas (of Callender's Cable and Construction Co.) has been appointed mains superintendent at Carlisle Corporation electricity works.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

The following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares busines being currently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while Share List will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise f possible inaccuracies.

STOCK EXCHANGE SETTLING DAYS.—Settling days on the Stock Exchange are as follows:—

Consols: April 5th. General Settlements: March 30th, April 13th, 28th. Bank Rate, March 9th, 1905, 2½ per cen

I.—ENGINEERING, IRON, AND STEEL COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
11,270	5	5%	Alldays & Onions Pneumatic Engineering, Ltd.	3	2¾— 3¼
10,000	5	3/-	Do. Cum. Pref. 6 per cent. ..	5	4½— 5
3,210,000	1	2/6	Armstrong (Sir W. G.), Whitworth and Co., Ltd.	1	3 3/16 – 3 7/16
76,970	5	2/-	Do. 4% Cum. Pref.. ...	5	5⅜— 5⅝
1,500,000	100	4%	Do. 4% 1st Mort. Dbs. Rd.	100	104 —106
£100,000	100	4½%	Aveling and Porter, Ltd., 4½% Reg. Mt. Debs. Red.	100	96 — 99
580,000	1	1/7½	Babcock and Wilcox, Ltd., Ord. ..	1	4¼— 4½
100,000	1	7½d.	Do. ,, 6% Cum. Pref.	1	1½— 1⅝
20,060	5	3/-	Baker (Joseph) and Sons, Ltd., 6% Cum. Pref.	5	5 — 5½
250,000	1	6¾d.	Baldwins, Ltd., 5½% Cum. Pref. ..	1	1 — 1⅛
£250,000	Stk	4½%	Do. 1st Mt. 4½% Deb. Stk. Red.	100	101 —103
150,000	4½	2/1½	Barrow Hæmatite Steel Co., Ld., O.	4½	1⅜ — 1⅝
50,000	4½	6/-	Do. do. Cum 2nd. Pref.	4½	4⅛— 4⅝
83,334	5	2/6	Bayliss, Jones and Bayliss, Ltd., 5% Cum. Pref. Shares	5	4¾— 5½
£500,000	100	—	Beardmore (Wm.) & Co., Ltd., 4½% 1st Mt. Debs., Red., Scrip 50% pd	—	103 —105
50,000	10	6/-	Bell Brothers, Ltd., 6% Cum. Pref.	10	11¾— 12¼
£366,600	Stk	4%	Do 4% Deb. Stock, Red.	100	99 —101
200,000	1	1/-	Beyer, Peacock and Co., Ltd., Ord.	1	⅞ —1 1/16
300,000	1	6¾d.	Do. 5½% Cum Pref.	1	27/32 — 29/32
£300,000	Stk	4½%	Do. 4½% Red. Deb. Stock	100	96 — 99
1,629,760	1	6d.	Bolckow, Vaughan and Co., Ltd., O. Nos. 1-1,629,760	1	1 —1 1/16
1,860,900	1	8¾d.	Do. Nos. 1,639,101-3,500,000	12/-	17/32— 19/32
1,160,000	1	4½d.	Brown (John) and Co., Lim., Ord., Nos. 1-1,160,000	15/-	1⅛ — 1¼
590,000	1	6d.	Do. Ord., Nos. 1,160,001-1,750,000	1	1 15/32— 1 17/32
74,000	10	5/-	Do. 5% Cum. Pref.	10	11¼— 11¾
154,500	5	2/6	Cammell, Laird & Co., Ltd., Ord. ..	5	8¼— 8¾
232,500	5	2/6	Do. 5% Cum. Pref. ..	5	5 5/16— 5 7/16
450,000	1	1/6	Clayton & Shuttleworth, Ltd., Ord.	1	1 — 1 1/16
70,000	5	2/6	Do. 5% Cum. Pref	5	5½— 5¾
£260,000	Stk	4%	Do 4% 1st Mort. Db. Stk. Red	100	100 —102
100,000	10	7/6	Consett Iron Co., Ltd., Ord.. ..	7½	31— 33
57 031	10	10/-	Crossley, Bros, Ld, Ord. 40840/97870	10	16 —16½
40,389	10	5%	Do. 5% Cum. Pref.	10	11⅜—11⅞
75,000	1	2/6	Delta Metal, Ltd. Shares	1	2 — 2¼*
1,259,594	1	8¾d.	Dorman, Long & Co., Ltd.	1	⅞— 15/16
£400,000	Stk	4%	Do. 4% 1st Mort. Perp. Deb. Stk.	100	91 — 94
200,000	5	3/-	Dunderland Iron Ore Co., Ltd., 6% Cum. Pref. and Participating..	5	3⅛— 3⅝
250,000	1	9¾d.	Dunlop (James) & Co., Ltd., Ord..	1	9/16— 11/16
300,000	1	7½d	Do. 6% Cum. Pref. ..	1	15/16 — 1
4,721	13	12/-	Ebbw Vale Steel, Iron & Coal Co., Ltd.	13	9 — 10
69,754	13	12/-	Do. do. do.	10	7¼— 7¾
20,250	10	8/-	Elliott's Metal, Ltd.	3	4¾— 5¼
5,000	10	5%	Do. Cum. Pref. 5%	10	8¾— 9¼
186,748	Stk	4%	Do. Deb. 4%	100	94½ — 96½
25,000	10	6/-	Fairfield Shipbuilding & Engng. Co., Ltd., 6% Cum. Pref. ..	10	10¾— 11¼
£250,000	Stk	4½%	Do. 4½% Mort. Deb. Stk. Red.	100	100 —103
9,000	10	10%	Fleming & Ferguson, Ltd. Ord. Nos. 1/9000..	10	12¼—12¾
6,000	10	5%	Do. 5% Cum Pref. Nos. 9001/15000	10	9½—10
126,000	8	3/-	Fraser & Chalmers, Ltd., Ord. ..	8	4⅜— 4⅞
21,000	8	1/6	Do. 7½% Cum. Pref.	8	5¾— 6¼
10,000	10	5%	Galloways, Ltd., 5% Cum. Pref. 18001/28000	10	6 — 7
£150,000	Stk	4%	Do. 4% 1st Mort. Deb Red..	100	90½—91½
16,800	10	—	Greenwood & Batley, Ltd., Ord. ..	10	4¼— 4¾
9,600	10	7%	Do. 7% Cum. Pref	10	10¼— 10¾
965,000	1	1/-	Guest, Keen & Nettlefolds, Ltd. Ord.	1	2⅛ — 2⅜
841,000	5	2/6	Do. 5% Cum. Pref.	5	6 — 6¼*
£1,850,500	Stk	4%	Do. 4% Irred. Mort. Deb. Stk	100	107 —109
18,000	5	2/6	Gwynnes, Ltd., 5% Cum. Pref. ..	5	2 — 3
250,000	1	8/6	Hadfield's Steel F'dry Co., Ld., Ord.	1	3 1/16—3 3/16*
20,000	10	4/6	Do. 4½% Cum. Pref.	10	10¾ — 11¼
30,000	5	3/-	Hall (J. & E.), Ltd. 6% Cum. Pref...	5	5 — 5½
408,505	1	1/6	Harvey United Steel Co., Ltd. ..	1	1 5/16—1 7/16*
47,500	10	7½%	Hawthorn, Leslie & Co., Ltd. Ord.	10	10¾— 11
28,001	5	7/-	Head, Wrightson & Co., Ltd. ..	5	5 — 5½
85,000	1	7½d.	Hill (Richard) & Co. (1899) Ld., Ord.	1	¾ — ⅞
18,000	5	3/-	Do. 6% Cum. Pref.	5	4⅜— 4⅞
30,000	10	6/-	Hornsby (Richard) & Sons, Ld., Ord.	8	5½— 6

ENGINEERING, IRON, AND STEEL COMPANIES.—Co

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.
750,000	1	6d.	Howard & Bullough, Ltd., Ord. ..	1
25,000	10	6/-	Do. 6% Pref. (Non-Cum.) ..	10
£250,000	Stk	4%	Do. 4% Deb. Stk., Red. after 19[illegible]	100
87,500	10	20	Kynoch, Ltd.	10
49,587	10	5%	Do. Cum. Pref. 5%	10
300,000	1	4½d	Lambert Bros., Ltd., Ord.	1
50,000	5	2/9	Do. 5½% Cum. Pref.	5
40,000	3	2/1½	Leeds Forge Co, 7% Cum. Pref. ..	3
200,000	1	7½d	Lysaght (John), Ltd., 6% Cum. Pf.	1
£300,000	Stk	4½%	Do 4½% 1st Mt. Deb. Stk., Red.	100
40,000	10	5/-	Mather & Platt, Ld., 5% Cum. Pref	10
210,000	1	8½d.	Measures Bros., Ltd., Ord.	1
75,000	1	6½d.	Do. 5½% Cum. Pref.	1
£75,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100
21,948	5	2/6	Muntz Metal, Ltd.	5
14,248	5	5%	Do. Pref. 5%	5
5,000	62½	47/6	Nantyglo and Blaina Iron Works, Ltd., 8% Cum. Pref.	62½
73,000	10	5/-	N. Brit. Loco. Co., Ltd., 5% Cm. Pf.	10
60,000	5	—	North-Eastern Steel Co., Ltd., Ord.	5
£250,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100
122,000	5	2/-	Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B"	5
50,000	5	3/-	Do. 6% Cum. Pref. "A" ..	5
70,000	10	6/-	Pease & Partners, Ltd., Ord. ..	10
£400,000	Stk	4%	Do. 4% Perp. Deb. Stock ..	100
30,000	5	3/-	Peebles (Bruce) & Co., Ld., 6% Cm.P.	5
65,000	1	—	Pooley (Henry) & Son., Ltd., Ord ..	1
13,000	5	—	Do. 5½% Cum. Pref.	5
280,000	1	—	Projectile Co. (1902), Ltd., Ord. ..	1
126,968	5	2/-	Rhymney Iron Co., Ltd.	5
78,062	5	2/-	Do. New	5
£380,000	—	5%	Do. 5% Mort. Deb., Red. ..	100
850,000	1	7½d.	Richardsons, Westgarth & Co., Ltd., 6% Cum. Pf. ..	1
£350,000	Stk	4½%	Do. 4½% Perp. Deb. Stock ..	100
85,000	10	12/-	Ruston, Proctor & Co., Ltd... ..	10
275.000	1	6d.	Scott (Walter), Ltd., Ord.	1
300,000	1	7½d.	Do. 6% Cum. Pref. ..	1
£300,000	Stk	4%	Do. 4% Perp. Deb. Stk.	100
£115,800	100	5%	Shelton Iron, Steel and Coal Co., Ld. 1st Charge 5% Debs.. Red ..	100
£97,900	100	6%	Do. 6% 2nd Mort. Debs., Red.	100
250,000	1	1/-	South Durham Steel & Iron, Ltd. Or.	1
300,000	1	7½d.	Do. 6% Cum. Pref...	1
£300,000	Stk	4½%	Do. 4½% Per. Deb. Stock	100
49,560	10	2½%	Steel Co. of Scotland Ord. 1/49560..	9
£125,240	Stk.	5%	Do. 5% Trust Mort. Deb. ..	100
25,000	10	—	Stephenson (Robert) & Co., Ltd., Or.	10
25,000	10	5/6	Do. 5½% Cum. Pref. ..	10
£250,000	Stk	4%	Do. 4% Perp. Deb. Stock	100
85,000	10	9/-	Stewarts & Lloyds, Ltd., Ord. ..	10
55,000	10	6/-	Do. 6% Cum. Pref.	10
684,782	1	6d.	Swan, Hunter & Wigham-Richardson, Lim. Ord.	1
538,845	1	6d.	Do. 5% Cum. Pref.	1
£240,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Red	100
800,000	1	6d.	Thames Iron Works, Shipbuilding & Engineering Co., Ltd., 5% Cum. Pf.	1
£200,000	100	4%	Do. 4% Irredeem. 1st Mort. Deb.	100
£160,000	1	7½d.	Thornycroft (John I.) & Co., Ltd. 6% Cum. Pref.	1
10,000	10	5/-	Tylor (J.) & Sons, Ltd. 5% Cum. Pf.	10
$508495200	$100	$½	United States Steel Corp. Com. Stk.	$100
$360814100	$100	$1¾	Do. 7% Cum. Pref. Stock	$100
$162268000	$1000	5%	Do. 10-60yr. 5% Skg. Fd. G. Bds.	$1000
3,850,000	1	1/6	Vickers, Sons & Maxim, Ltd. Ord..	1
750,000	1	6d.	Do. 5% Non-Cum. Pref. ..	1
£750,000	Stk	5%	Do. 5% Non-Cum. Pref. Stock.	100
£1,250,000	Stk	4%	Do. 4% 1st. Mort. Deb. Stk. Red.	100
£1,000,000	100	4½%	Do. 4½% 2nd Mort. Debs., Red.	100
225,000	1	1/2½	Weardale Steel, Coal & Coke, Ltd., Def. Ord.	1
500,000	1	7½d.	Do. 6% Cum. Pref. Ord. ..	1
£300,000	Stk	4%	Do. 4% Perpetual Deb. Stock	100
7,637	5	2/9	Weldless Steel Tube, Ltd., Cum. Pref. 5½	5
300	Stk	4½%	Do. Mort. Deb. 4½%	100
66,666	5	3/.	Willans & Robinson, Ord.	5
66,666	5	3/-	Do. 6% Cum. Pref.	5
£246,641	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red	100
£150,000	Stk	4½%	Yorkshire Iron & Coal Co., Ltd., 4½% 1st Mort. Deb. Stk. Red.	100

Stocks and Shares marked * are quoted ex-dividend.

II.—ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name	Paid up.	Closing Prices.
70,000	1	6d.	Alliance Elec. Co., Ltd. 5% Cum. Pf.	1	⅝—⅞
125,000	1	7⅕d.	Aron Elec. Meter Ltd., 6% Cum. Pf.	1	7/16—9/16
120,000	1	9⅝d.	Bell's Asbestos Co., Ltd.	1	¾—⅞
100,000	5	4/-	British Insulated & Helsby Cables Ltd., Ord. ..	5	5¾—6¼
100,000	5	3/-	Do. 6% Cum. Pref.	5	5¼—5¾
£500,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Rd.	100	101—104
£200,000	Stk	4½%	British Thomson-Houston Co., Ltd., 4½% 1st Mort. Deb. Stk. Red. ..	100	99—101
400,000	5	3/-	British Westinghouse Electric and Manufac. Co., Ltd., 7% Pref. ..	5	3⅛—3⅜
£616,353	Stk	4%	Do. 4% Mort. Deb. Stk. Red...	100	91—93
105,731	2	2/-	Brush Elec. Enging. Co., Ltd., Ord..	2	½—¾
150,000	2	2/4⅘	Do. 6% Pref.	2	1½—1¾
£125,000	Stk	4½%	Do. 4½% Perp. 1st Deb. Stk...	100	92—95
£125,000	Stk	4½%	Do. 4½% Perp. 2nd Deb. Stk.	100	79—82
35,000	5	5/-	Callender's Cable & Constn. Ltd. Ord.	5	11—11½
40,000	5	2/6	Do. 5% Cum. Pref.	5	5⅜—5⅝
£200,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Red.	100	106—108
85,000	3	1/6	Crompton & Co., Ltd...	3	2⅛—2⅜
£100,000	—	5%	Do. 5% 1st Mort. Reg. Debs.	100	93—98
52,000	5	10/-	Dick, Kerr & Co., Ltd., Ord. ..	5	8—8½
61,000	5	8/-	Do. 6% Cum. Pref.	5	5⅞—6⅛
£300 000	Stk	4½%	Do. 4½% Deb. Stock, Red. ..	100	106—108
283,334	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	1⅛—1⅜
£233,334	Stk	4%	Do. 1st Mort. 4% Iree. Deb. Stk.	100	106—109
99,261	5	1/6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	3	1—1¼
17,139	5	2/6	Do. "A" Shares Nos. 01-017,139	5	1¾—2¼
£344,023	Stk	4%	Do. 4% Deb. Stock Red. ..	100	80—85
£100,000	Stk	5%	Do. 5% Second Deb. Stk. Red.	100	86—91
112,100	2	1/7½	Electric Construction Co., Ltd. ..	2	1⅛—1¼
31,390	2	2/9⅗	Do. 7% Cumulative Pref. ..	2	2¼—2½
£200,000	Stk	4%	Do. 4% Perp. 1st Mt. Deb. Stk.	100	97—99
10,248	10	7/6	Evered and Co., Ltd...	10	12—14
£100,000	Stk	5%	Ferranti, Ltd., 5% 1st Mort. Deb. Stock, Red...	100	90—95
25,000	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9½—10
£200,000	Stk	4%	Do. 4% 1st. Mt. Deb. Stk., Red.	100	91—96
35,000	5	10/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	12¾—13*
35,000	5	2/3	Do. 4½% Cum. Pref.	5	5⅜—5⅝
£50 000	Stk	4½%	Do. 4½% Mt. Deb. Stk. Red.	100	109—111
50,000	10	5/-	India Rubber, Gutta Percha & Telegraph Works Co., Ltd.,	10	16—17
£300,000	100	4%	Do. 1st Mort. Deb. Red. ..	100	100—103
7,500	10	—	Parker, Thos., Ltd.	10	6½—7
100,000	1	3%	Scott (Ernest) & Mountain, Ld., Ord.	1	16/-—17/-
37,350	12	24/-	Telegraph Construction and Maintenance Co., Ltd.	12	36—38*
£150,000	100	4%	Do. 4% Deb. Bonds	100	103—105

III.—ELECTRIC TRACTION.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
120,000	5	3/-	Anglo-Argentine Trams Co., Ld., Or.	5	8½—8¾
260,007	5	2/6	Do. 5% Cum Pf.	5	5⅝—5⅞
£230,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888 ..	100	140—143
20,000	10	6/-	Barcelona Trams Co., Ltd., Ord. ..	10	12—12½
10,000	10	5/-	Do. 5% Cum Pf. Shares	10	9—10
£46,300	100	5%	Do. 5% Debs., Red. ..	100	99—102
£191,326	Stk	4½%	Do. 4½% Red. Deb. Stk.	100	96—100
75,606	1	—	Bath Elec. Trams. Ld., Pf. Or. ..	1	13/16—15/16
59,394	1	11·49d	Do. 5% Cum. Pf. ..	1	15/16—1 1/16
75,000	5	—	Brisbane Electric Tram Investment Co., Ltd., Ord... ..	5	1—1½
75,000	5	2/6	Do. 5% Cum. Pf. ..	5	3¾—4¼
£425,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	94—98
£200,000	Stk	6%	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	103—106
		%	Pref. Ord. Stock	100	100—103
133,301	10	6/-	Brit. Electric Traction, Ltd., Ord.	10	9¼—9¾
156,437	10	6/-	Do. 6% Cum. Pref.	10	10⅞—11⅛
£1,000,000	Stk	5%	Do. 5% Perp. Deb. Stk. ..	100	122—124
£250,000	Stk	4½%	Do. 4% 2nd Deb. Stk. Red..	100	98—100
100,000	5	1/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	3¾—4
40,500	5	3/-	Do. "A" 6% Cum Pref. ..	5	5⅝—5⅞
27,000	5	3/-	Do. "B" do.	5	5⅜—5⅝

ELECTRIC TRACTION.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£200,000	Stk	5%	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	95—98
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	103—106
102,268	5	3/-	Calcutta Tramways Co., Ltd. ..	5	8¼—8½
£350,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	106—108
480,000	1	6d.	Cape Electric Tramways, Ltd. ..	1	1⅜—1⅝
40,000	5	2/6	City of Birmingham Trams Co., Ltd. 5% Cum. Pref.	5	4⅞—5⅛
£300,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	101—104
£120,000	Stk	5%	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	103—105
60,000	10	6/-	Dublin United Trams. Co. (1896), Ltd., Ord. ..	10	13—14
59,987	10	6/-	Do. 6% Pref...	10	15½—16½
30,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	3—3½
£150,000	Stk	4%	Do. 4% Deb. Stock.. ..	100	89—92
125,000	10	5/-	London United Trams. (1901), Ltd., 5% Cum. Pref.	10	10—10½
£1,031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	99—102
£50,000	Stk	5%	Madras Electric Trams (1904), Ltd., 5% Deb. Stock, Red.	100	101—103
314,016	1	—	Metropolitan Elec. Trams, Ltd., Def.	1	11/32—13/32
500,000	1	6d.	Do. 5% Cum. Pref... ..	1	1 1/32—1 3/32
£350,000	Stk	4½%	Do. 4½% Deb. Stock, Red.	100	105—107
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	½—1½
110,923	8	3/2⅖	North Metropolitan Tramways Co..	8	3¾—4¼
£150,000	100	3½%	Do. 3½% Mort. Debs.	100	90—95
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red..	100	104—107
24,500	10	10/-	Potteries Elec. Traction Co., Ld., Or.	10	9½—10
24,500	10	5/-	Do. 5% Cum. Pref. ..	10	9¼—9¾
£220 000	Stk	4½%	Do. 4½% Deb. Stk., Red.	100	102—105

IV.—ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
7,500	10	16/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. ..	10	12¼—12¾
7,500	10	4/6	Do. 4½% Cum. Pref. ..	10	9¾—10¼
7,500	10	6/-	Do. 6% Cum. Second Pf. ..	10	11—12
£70,000	Stk	4½%	Do. 4½% Deb. Stock Red ..	100	105—107
14,000	5	2/-	Bromley (Kent) Elec. Lt. & Pr. Co. Ld	5	5¼—5¾
£50,000	Stk	4½%	Do. do. 4½% 1st Deb. Stk. Red.	100	101—104
27,507	5	4/6	Brompton & Kensington Elec. Supply Co., Ltd. Ord. ..	5	10¼—10¾
12,493	5	3/6	Do. 7% Cum. Pref. Shares..	5	10—10½
60,000	5	3/-	Calcutta Elec. Sup. Cor. Ltd., Ord..	5	9—9¼
£288,782	Stk	4%	Central Elec. Sup. Co., Ltd., 4% Gua. Deb. S.k. ..	100	105—108
70,000	5	4/-	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord... ..	5	8—8½
80,000	5	2/3	Do. do. 4½% Cum. Pref...	5	5½—5¾
£350,000	Stk	4%	Do. do. 4% Deb. Stk. Red.	100	105—107
44,436	5	3/9	Chelsea Elec. Sply. Co., Ltd., Ord.	5	6¾—7¼
£150,000	Stk	4½%	Do. do. 4½% Deb. Stk., Red	100	109—111
70,595	10	7/-	City of London El. Lghtg. Co., Ld., O.	10	11¾—12¼*
40,000	10	6/-	Do. 6% Cum. Pref.	10	13½—14*
£400,000	Stk	5%	Do. 5% Deb. Stk., Red ..	100	123—127
£300,000	Stk	4½%	Do. 4½% 2nd Deb. Stk., Red	100	103—105
40,000	10	4/-	County of London Elec. Supply Co., Ltd., Ord.	10	9½—10
30,000	10	6/-	Do. 6% Cum. Pref.	10	12¼—12¾
£400,000	Stk	4½%	Do. 4½% Deb. Stk., Red. ..	100	110—113
70,000	5	2/6	Edmundson's Elec. Cor. Ltd., Ord.	5	6½—6¾
70,000	5	3/-	Do. 6% Cum. Pref.	5	6⅛—6⅜
£300,000	Stk	4½%	Do. 4½% 1st Mort. Db. Stk. Reg	100	106—108
£80,000	Stk	5%	Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. Stk. Red.	100	86—91
10,000	5	2/-	Folkestone Elec. Supply Co., Ld., O.	5	5½—6
£50,000	Stk.	4½%	Do. 4½% 1st Deb. Stk., Red.	100	101—104
15,000	10	—	Havana Electricity Co., Ltd... ..	10	9½—10½
13,000	5	3/6	Hove Elec. Lighting Co., Ltd., Ord.	5	7¾—8¼
£50,000	Stk	4½%	Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock, Red.	100	101—103
150,000	1	—	Kalgoorlie Electric Power & Lighting Corp, Ltd., 6% Cum. Pref.	1	⅝—¾
21,000	5	7/-	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord. ..	5	12¾—13¼

Stocks and Shares marked * are quoted ex-dividend.

ELECTRIC LIGHTING AND POWER.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£185,000	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	102 —104
111,000	8	1/9⅜	London Elec. Supply Corp., Ld., Ord.	8	2⅝ —2 13/16
60,000	5	3/-	Do. 6% Pref.	5	5¾ — 6
£371,895	Stk	4%	Do. 4% 1st Mort. Db. Stk., Red.	100	99 —101
100,000	10	11/-	Metropolitan Elec. Sup. Co., Ld., Or.	10	18½—18¾*
76,121	5	2/3	Do. 4½% Cum. Pref.	5	5⅝ — 5¾
220,000	Stk	4½%	Do. 4½% 1st Mort. Db. Sk., Red.	100	110 —115
250,000	Stk	3½%	Do. 3½% Mort. Deb. Stk., Red.	100	97 — 99
£250,000	—	4½%	Midland Elec. Corp. for Power Distribution, Ld., 4½% 1st Mort. Deb.	100	97 —100
10,852	10	8/-	Notting Hill Elec. Ltg. Co. Ltd. Ord.	10	14½—15½*
£59,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	102 —104
16,500	5	4/6	Oxford Electric Co. Ltd., Ord. ..	5	6⅛ — 6⅜*
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	98 —100
£84,700	100	4½%	Royal Elec. Co. (of Montreal) 4½% 20-yr. 1st Mort. Deb	100	100 —102
40,000	5	9/6	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	14 —14½
20,000	5	3/6	Do. 7% Pref...	5	8½— 8¾
£150,000	Stk	3½%	Do. 3½% Deben. Stock, Red	100	98 —100
12,000	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2⅝— 3⅛
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	79 — 83
65,000	5	4/-	South London Elec. Sup. Co., Ltd. O.	5	4⅛— 4⅜*
100,000	1	—	South Metropolitan Elec Light & Power Co., Ltd. Ord.	1	⅞ — 1
50,000	1	8⅜d.	Do. 7% Cum. Pref.	1	1 5/16—1 7/16*
£100,000	Stk	4½%	Do. 4½% 1st Deb. Stock Red.	100	107 —110
50,000	5	2/6	Urban Electric Supply Co., Ltd., O.	5	5 1/16—5 3/16
30,000	5	2/6	Do. 5% Cum Pref.	5	5⅛— 5¼
£200,000	Stk	—	Do. 4½% 1st Mort. Deb. Stk. Red	100	106 —108
110,000	5	7/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	12¾ —13¼
28,151	5	2/6	Do. 5% Cum. Pref.	5	6½— 6¾

V.—TELEGRAPH & TELEPHONE COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£34,800	100	4%	African Direct Tel. Co., Ld., 4% Mt. Debs. (Series A), Red.	100	99 —102
25,000	10	—	Amazon Telegraph Co., Ld... ..	10	2¼ — 2¾
£763,580	Stk	17/6	Anglo-American Tel. Co., Ltd., Ord.	100	61 — 63
£3,118,210	Stk	35/-	Do. 6% Preferred Ordinary	100	108½—109½
£3,118,210	Stk	2/-	Do. Deferred Ordinary ..	100	17⅛—17⅝
44,000	5	3/-	Chili Telephone Co., Ltd.	5	6⅛— 6⅝
$15,000,000	$100	$2	Commercial Cable Co., Capital Stk.	$100	230 —240
£1,903,856	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	98 —100
16,000	10	5/-	Cuba Submarine Tel. Co., Ld., Ord.	10	8¾— 9¼
6,000	10	10/-	Do. 10% Preference	10	17 — 18
6,000	5	2/-	Direct Spanish Telegraph Co., Ord.	5	3⅜— 3⅝
		5/-	10% Cum. Preference	5	8¼— 8¾
£30,000	50	4½%	Do. 4½% Debs...	50	101-103%
60,710	20	3/-	Direct U.S. Cable Co., Ltd... ..	20	11⅜—11⅝
£85,800	100	4½%	Direct West India Cable Co., Ltd., 4½% Reg. Debs.	100	100—102
£300,000	100	4%	East. & S. African, Ld., 4% Mt. Dbs.	100	100—102
£200,000	25	4%	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)..	25	101-103%
300,000	10	2/6	Eastern Extension, Australasia and China, Ltd...	10	14½— 15
£602,400	Stk	4%	Do. 4% Mort. Deb. Stk., Perp.	100	105 —107
£4,000,000	Stk	25/-	Eastern Tele. Co., Ltd., Ord. ..	100	145 —148
£2,000,000	Stk	17/6	Do. 3 % Pref.	100	92 — 94
£1,836,814	Stk	4%	Do. 4% Mort. Deb.	100	107 —109
150,000	10	5/-	Great Northern Telegraph Co., Ltd., (of Copenhagen) ..	10	34½— 35½
£58,700	100	4½%	Halifax and Bermudas Cable Co., Ltd., 4½% 1st. Mort. Debs. Red.	100	100—102
17,000	25	12/6	Indo-European Tele. Co., Ltd. ..	25	47 — 49
72,680	1	7½d.	Monte Video Telephone Co., Ltd., O.	1	13/16— 15/16
£1,983,333	Stk	6%	National Telephone Co., Ltd., Pref.	100	110 —111*
£1,966,667	Stk	5%	Do. Deferred	100	104—106*
250,000	5	2/6	Do. 5% Non-Cum. 3rd Pref.	5	5⅜ — 5⅝*
£2,000,000	Stk	3½%	Do. 3½% Deb. Stk., Red. ..	100	100—102
£689,593	Stk	4%	Do. 4% do. do. ..	100	104 —106
179,313	1	7½d.	Oriental Telephone & Elec. Co., Ltd.	1	1¼ — 1⅜
50,000	1	7½d.	Do. 6% Cum. Pref.	1	1 3/16 — 1 5/16
£100,000	100	4%	Pacific & European Tel. 4% Guar. Debs. Red...	100	98 —101
11,839	8	4/-	Reuter's Telegram Co., Ltd. ..	8	7¼ — 7¾
58,000	5	3/-	United River Plate Telep. Co., Ltd.	5	7¼— 7¾
40,000	5	2/6	Do. 5% Cum. Pref.	5	5 — 5¼
£179,947	Stk	5%	Do. 5% Deb. Stock, Red. ..	100	107—109
15,609	10	4/-	W. African Telegraph Co., Ltd. ..	10	8 — 8½
£30,008	2½	—	West Coast of America, Ltd. ..	2½	5/16 — 7/16
150,000	100	4%	Do. 4% Deb. Guar. by West. Tel.	100	100 — 102

TELEGRAPHS AND TELEPHONES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name	Paid up.	Cl Pr
88,321	10	6d.	W. India & Panama Teleg. Co., Ld., Or.	10	[illegible]
84,568	10	6/-	Do. 6% Cum. 1st. Pref. ..	10	6
4,669	10	6/-	Do. 6% Cum. 2nd Pref. ..	10	6
£80,000	100	5%	Do. 5% Deb.	100	108
207,980	10	3/-	Western Telegraph Co., Ltd. ..	10	14
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	101
518,915	Stk	4%	Do. 4% Deb. Stock, Red. ..	100	108

VI.—SHIPPING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Cl Pr
82,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 5½% Cum. Pref.	10	[illegible]
£825,000	Stk	4½%	Do. 4½% Red. 1st Mort. Deb. Stk.	100	99
£672,900	Stk	4½%	British & African Stm. Nav. (1900) Ltd., 4½% 1st Mort. Deb. Stk. Red.	100	98
40,000	10	5/6	Bucknall Steamship Lines, Ltd., 5½% Cum. Pref.	10	6
£600,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk.	100	75
£750,000	Stk	4½%	Clan Line Steamers, Ltd., 4½% Deb. Stk. Red. ..	100	98
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000..	20	[illegible]
40,000	20	8/-	Do. Nos. 60,001-100,000	10	[illegible]
£461,480	Stk	4½%	Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. ..	100	101
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord..	1	[illegible]
25,828	7½	4/7	Gen. Steam Navigation Co., Ld., Ord.	7½	[illegible]
86,758	8	4/9⅜	Do. Non-Cum. 6% Pref... ..	8	[illegible]
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	[illegible]
55,000	5	1/3	Houlder Line, Ltd., Ord.	5	[illegible]
40,000	5	2/9	Do. 5½% Cum. Pref.	5	[illegible]
£200,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk. Red.	100	[illegible]
141,500	10	5/-	Leyland (Fredk.), & Co., (1900), Ltd., 5% Cum. Pref. ..	10	[illegible]
£1,160,000	Stk	5 %	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. ..	100	[illegible]
£1,160,000	Stk	19%	Do. do. Deferred ..	100	[illegible]
15,000	100	80/-	Royal Mail Steam Packet Co. Ord..	60	[illegible]
89,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref..	5	[illegible]
89,075	5	2/6	Do. "B" Ord...	5	4
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord..	10	[illegible]
24,000	10	4/6	Do. 4½% Cum. Pref... ..	10	[illegible]
£1,008,894	Stk	4%	Do. 4% Debenture Stk., Red.	100	[illegible]

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	C
60,000	1	9⅜d.	Chadburn's (Ship) Tele. Ltd., Ord...	1	
£750,000	Stk	9%	General Hydraulic Power Co., Ltd.	100	[illegible]
12,500	10	10/-	Oakey (John) and Sons, Ltd., Ord..	10	[illegible]
10,000	10	6/-	Do. do. 6% Cum. Pf.	10	14
183,588	1	6·3d.	Power Gas Corp., Ltd., Ord., Nos. 66,463-250	15/-	[illegible]
66,462	1	8·4d.	Do. do. Nos. 1 66,462	1	[illegible]
185,000	1	6d.	Waygood (R.) & Co., Ltd., Ord. ..	1	[illegible]
185,000	1	7½d.	Do. 6% Cum. Pref. ...	1	[illegible]

RAILWAY CARRIAGE & WAGON COMPANI

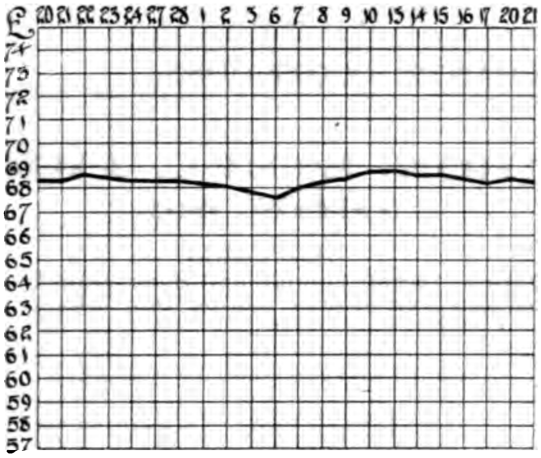
Present Amount Subscribed,	Shares.	Last Dividend.	Name.	Paid up.	C
10,000	10	7/6	Birm. Railway-Car, & Wagon, L., 1-10,000	10	[illegible]
8,739	10	8/-	Do. Second Issue 1-8,739....	4	[illegible]
10,000	10	6/-	Do. Cum. Pref. 6% 1-10,000..	10	[illegible]
30,111	7	7/-	Gloucester Rail.-Car & Wagon, Ld., A, 1-29,861 & 49,751-50,000	7	[illegible]
44,889	7	3/6	Do. B, 29,862-49,750, 50,001-75,000	7	[illegible]
14,567	10	1/3	Lancashire Wagon, Ord.	2	[illegible]
4,150	10	5%	Do. do.	10	[illegible]
781,808	1	9d.	Metropolitan Amalgamated Rail.-Carriage & Wagon, Ld., 1-784,808	1	[illegible]
164,288	1	6d.	Do. Cum. A Pref. 5% 1-164,288	1	[illegible]
235,000	1	7½d.	Do. Cum. B Pref. 6% 1-235,000	1	[illegible]
20,000	20	20/-	Midland Rail.-Car. & Wagon, Ld., 1-20,000	10	[illegible]

Stocks and Shares marked * are quoted ex-dividend.

THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM FEBRUARY 20TH TO MARCH 21ST, 1905.

COPPER.



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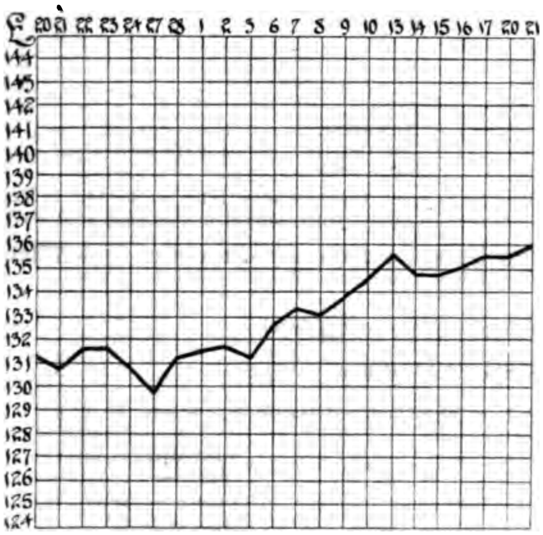
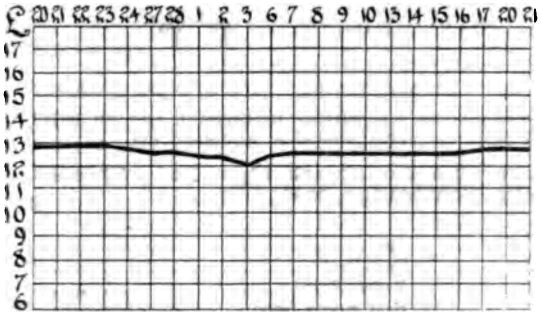
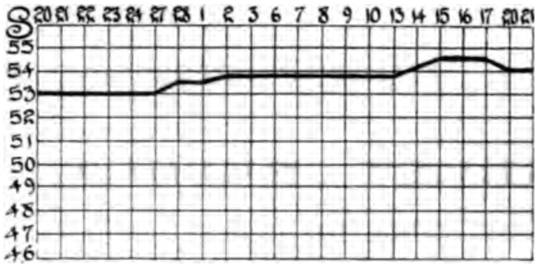


ENGLISH LEAD.



PIG IRON: SCOTCH,



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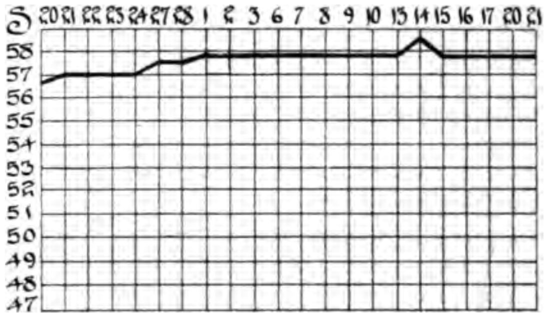
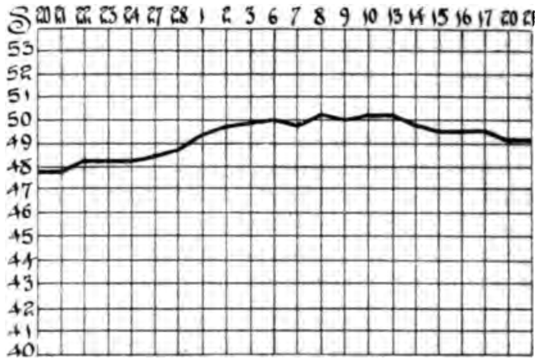


CLEVELAND.



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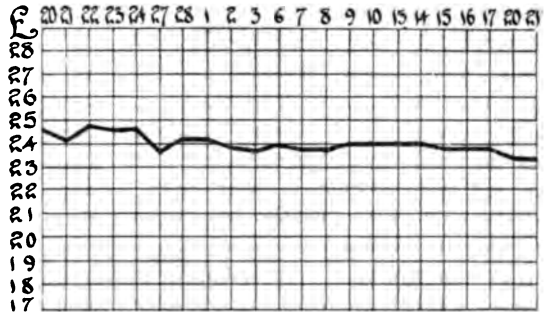


PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

MARKET REPORT.

Wednesday, March 22nd, 1905.

AFTER a spurt to the highest price of the present year the Copper market has quieted down. The situation is not materially different, American advices still being very favourable, and it is tolerably certain that stocks in Europe must now be lower than the average, while the falling off of American shipments to this side is an evidence of the increasing consumption in the United States. The price yesterday for standard copper was £68 2s. 6d. cash and £68 8s. 9d. three months.

The Tin market has been very buoyant although most of the buying has been on account of continental houses. The stock of Banca tin in Holland has been practically cleared out owing to a rush of buying orders, and most of the metal went at a considerable advance over London parity. A large account for the rise appears to have been opened, and a sharp advance took place to-day, cash metal touching £136 5s. Three months' metal is quoted £134 15s.

Lead remains steady, some fairly good buying having been in evidence, and with smaller arrivals in London the statistical position has improved. The next move in the market will probably be upward. To-day's closing prices were £12 10s. soft foreign, prompt, and May-June, £12 12s. 6d. English is quoted £12 15s.

In the Spelter market, orders have been filled at very moderate prices, and in spite of the fact that producers are pretty well sold, sellers have been in the majority, so that some decline from the highest prices of the week is to be noted. The last quotation to-day was 23¼ ⅜.

Iron and steel is steady; pig-iron has been quieter at lower prices, Cleveland being quoted 49s. 6½d. cash, and 49s. 9d. one month. Reports from the States described the condition of the markets as somewhat irregular, and these brought in their train a crop of realisations on the part of holders who began to fear a possible check to the American boom. Later advices, however, are couched in a more optimistic strain, and large orders are stated to have been placed by the leading railway companies for equipment, with the result that the process of realisation has practically ceased. Reports from our own trade centres are not quite so encouraging.

IRON, STEEL, PIG-IRON, &c.

SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as follows. Prices delivered in Glasgow or equal:—

Steel:		£	s.	d.
DALZELL	Siemens' Steel Plates, Marine Boiler Quality ..	6	15	0
♛♛	,, ,, ,, Land ,, ,, ...	6	17	6
STEEL	,, Steel Bars, Boiler Quality	6	17	6
DALZELL	Siemens' Steel Plates, Ship Quality Plates......	5	17	6
♛	,, ,, Bars ,, ,, ...	6	7	6
STEEL	,, ,, Angles............................	5	7	6

Manufactured Iron:

		£	s.	d.
Bars—Dalzell	....	6	2	6
,,	Best	6	12	6
,,	,, Horseshoe	6	12	6
,,	Angle..	6	2	6
,,	Best Angle	6	12	6
,,	Best Best	7	2	6
,,	Extra Best	7	12	6

Usual terms and extras. Special rates for delivery in England and export. The above prices subject to alteration without notice.

The Glasgow Iron and Steel Co., Ltd., Wishaw, quote as under (prices are delivered Glasgow or equal):—

	£	s.	d.	
Steel Angles (Glasgow ♔ Steel)...............	5	7	6	per ton
Steel Ship Plates (Glasgow ♔ Steel)	5	17	6	,,
Steel Bars, Ship Quality (Glasgow ♔ Steel)	6	7	6	,,
Steel Bars, Boiler Quality (Glasgow ♛ ♛ Steel)	6	17	6	,,
Steel Land Boiler Plates (Glasgow ♛ ♛ Steel)	6	7	6	,,
Steel Marine Boiler Plates (Glasgow ♛ ♛ Steel)	6	7	6	,,

Less 5 per cent. discount. Extras as per standard list.

Special prices for delivery in England and for export. The above prices subject to alteration without notice.

John Spencer (Coatbridge), Ltd., Phoenix Ironworks, Coatbridge, N.B., quotes:—

		£	s.	d.
Bars—Phœnix	....	6	5	0
,,	Best	6	15	0
,,	Best Best	7	5	0
,,	Extra Best..................................	7	15	0
,,	Best Horse Shoe	6	15	0
,,	Extra B.H.S.	7	15	0
,,	Extra Best Cable	8	5	0
,,	Rivet	6	5	0
,,	Best Scrap Rivet	7	5	0

	£	s.	d.
Angles—Phœnix	6	5	0
,, Best	6	15	0
,, Extra Best	7	5	0
Gas Tube Hoops—Phœnix Best	6	15	0
Plates—Phœnix	—		
,, Best Boiler	7	10	0
,, Best Best Boiler	8	0	0
,, Extra Best Boiler	9	0	0
Boiler Tube Strips—Phœnix Best Best	8	0	0

All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly.

Messrs. R. Feldtmann and Co., of Glasgow, quote Commission extra).

Pig Iron:

	No. 1. £	s.	d.	No. 3. £	s.	d.
Coltness, f.a.s. Glasgow	3	4	6	2	14	0
Gartsherrie ,,	2	19	0	2	14	0
Summerlee ,,	2	19	0	2	14	0
Carnbroe ,,	2	16	6	2	12	6
Langloan ,,	3	4	0	2	15	0
Calder ,,	2	19	0	—		
Clyde ,,	2	18	6	2	13	6
Glengarnock, f.o.b. Ardrossan	2	18	0	2	12	6
Eglinton ,, ,,	2	14	6	2	12	6
Dalmellington, ,, Ayr	2	14	6	2	12	6
Shotts ,, Leith	2	19	0	2	14	6

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, **at works:—**

	£	s.	d.
W.W. ♛ Bars	6	12	6
W.W. Best Bars	7	2	6
W.W. Best Best	7	12	6
W.W. Best Best Best	8	2	6
W.W. Best Shoe	7	2	6
Thornaby ♛	8	2	6
Thornaby Best	8	12	6
Thornaby Best Best	9	12	6
Whitwell Special Admiralty Cable	10	5	0
Special Chain Iron	9	5	0
Tube and Nail Strips	6	15	0
W.W. ♛ Angle Iron	6	15	0
W.W. Best Angle Iron	7	5	0
Tee Iron, to 8-inches United	7	12	6

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington, quote:—

		Iron. £	s	d.	Steel. £	s.	d.
♛ (SN)	Bars	6	10	0	7	5	0
	Angles	7	0	0	7	5	0
	Tees	7	10	0	7	15	0
♛ W.I.W	Hoops	7	0	0	7	10	0
	Sheets	7	10	0	8	0	0

Ordinary Sizes, F.A.S. Liverpool in 10-ton Lots.
Extras for Sizes and Cutting as per List.

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

Black Sheets:	Singles 20 G 96in. by 36in. per ton. £	s.	d.	Doubles 21 G to 24 G 96in. by 36in. per ton. £	s.	d.
"Vale"	10	0	0	10	10	0
"Shield"	10	10	0	11	10	0
"Severn"	11	10	0	12	10	0
"Baldwin Wilden B."	12	10	0	13	10	0
Charcoal	16	10	0	17	10	0
Best Charcoal	18	10	0	19	10	0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:	£	s.	d.	£	s.	d.
No. 3 Lead	13	10	0	14	10	0
S.V. Lead	15	0	0	16	0	0
No. 3 Terne	15	0	0	16	0	0
S.V. Terne	16	10	0	17	10	0

Tinned Sheets:	Singles 20 G to 108 by 36in. per ton. £	s.	d.	Doubles 21 to 24 G to 96 by 36in. per ton. £	s.	d.
Best Coke (Finish)	28	0	0	29	10	0
,, Charcoal (Finish)	30	0	0	31	10	0
Extra ,, ,,	32	0	0	33	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.

Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box.

Extreme sizes in Tin and Patent Coated specially quoted for.

Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.

At works less 2½% for cash monthly, 10th inst.

Galvanized Corrugated Sheets:

	£	s.	d.	
"Phœnix" Brand, 24 G., f.o.b. London, in Bundles	11	12	6	per ton.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	14	5	0	,,

Galvanized Working Up-Sheets:

	£	s.	d.	
24 G., f.o.b. London, in Bundles	13	12	6	per ton.

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£	s.	d.	
Crown Bars	6	10	0	per ton.
Best Bars (1 to 6in. wide, above ¼ in. thick, ½ in. to 4 rounds and squares)	7	0	0	,,
Angles	6	15	0	,,
,, Best	7	5	0	,,
T's	7	0	0	,,
,, Best	7	10	0	,,
Best Shoe Iron	8	0	0	,,
,, Rivet Iron	8	0	0	,,
,, Best Rivet (Special)	9	5	0	,,
,, Cable	9	5	0	,,
,, Screwing	8	5	0	,,

	£	s.	d.	
Best Turning	8	0	0	per ton.
,, Plating	8	5	0	,,
Best Best	9	5	0	,,
Treble Best	10	5	0	,,
Plates	7	10	0	,,
Best Plates	8	0	0	,,
,, Boiler Plates	8	10	0	,,
,, Best Boiler Plates	9	10	0	,,
Treble Best Boiler Plates	12	0	0	,,

Delivery f.o.b. Liverpool, Birkenhead or Manchester.

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon., quote "Star" brand patent wrought nails, steel nails, &c.

Discounts—

45 per cent. off 1-inch to 3-inch strong rose and all fine rose and 6dy. and 8dy. pound.

40 per cent. off 3½ inch to 7-inch strong rose and 10dy. and 20dy. pound.

40 per cent. off all sharp-pointed nails.

Delivered in lots of 4 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis :—
2 tons 9/6 per cwt.
4 cwt. lots and upwards 9/9 per cwt. } d/d any Railway Station.

Steel cut nails, 3-inch basis—
2 tons 8/3 per cwt.
4 cwt. lots 8/6 per cwt. } d/d any Railway Station.
Slit rods (iron) £7 10s. per ton, at works for 2-ton lots.

Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E. C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla, quote :—

Coke Tin-plates.	Per Box. f.o.b. Wales. £	s.	d.
C 18¾ by 14 124s. 110 lb. "BV"	0	12	0
C 20 by 10 225s. 155 ,, "Jumbo"	0	17	0
C 20 by 14 112s. 108 ,, "Lydbrook"	0	11	9
C 28 by 20 112s. 216 ,, "Lydbrook"	1	3	9
Charcoal Tinplates:			
C 20 by 14 112s. 108 lb. "Allaway"	0	12	6

BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes :—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

Steel:		£	s.	d	
Blooms	at	3	12	0	per ton.
Billets	at	3	14	0	,,
Sheet Bars	at	3	16	0	,,
Finished Steel:					
Bars	at	5	0	0	per ton.
Angles	at	5	1	0	,,
Tees	at	5	4	0	,,
Joists	at	4	10	0	,,
Fencing Standards	at	5	2	0	,,
Shoeing Bars	at	5	4	0	,,
Tyre Bars	at	5	4	0	,,
Half-Round Bars	at	5	5	0	,,
Heavy Rails	at	4	15	0	,,
Light Rails	at	4	17	6	,,

Structural Steelwork:

Prices on application.

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote :—

TIN.

Tin:	£	s.	d.		£	s.	d.	
English Ingots, f.o.b. Dis. 1¼% & 1%	135	10	0	to	136	0	0	per ton.
English Bars, f.o.b. Dis. 1¼% & 1%	136	10	0	to	137	0	0	,,
Straits G.M.B., cash Warehouse, Net	135	15	0	to	135	17	6	,,
Straits G.M.B., 3 months, Warehouse, Net	134	10	0	to	134	12	6	,,
Australian, Mt. Bischoff, Warehouse, Net	135	10	0	to	138	10	0	,,

COPPER.

Copper:	£	s.	d.		£	s.	d.	
Standard G.M.B., cash Warehouse, Net	68	7	6	to	68	10	0	per ton.
Standard G.M.B., 3 months, Warehouse, Net	68	13	9	to	68	15	0	,,
English, Tough, Cake & Ingot, Warehouses, Net	71	5	0	to	71	15	0	,,
English, Best Select, Warehouse Net	72	10	0	to	73	0	0	,,
English, Sheets and Sheathing, f.o.b., Dis. 2½%	82	0	0	to	82	10	0	,,
English Sheets for India, f.o.b., Dis. 2½%	76	0	0	to	76	10	0	,,
Electro, Warehouse, Net	70	15	0	to	71	0	0	,,
Ore, ex. ship	0	12	0	to	0	13	0	per unit
Regulus, Matte and Precipitate, ex. ship,	0	13	3	to	0	14	0	,,

YELLOW METAL.

Yellow Metal:	£	s.	d.	£	s.	d.	
Sheets, 4 by 4 feet for India f.o.b. Dis. 2½%				0	0	6¾	per lb
Sheathing ,, ,,				0	0	6⅞	,,

SPELTER.

	£	s.	d.		£	s.	d.	
Silesian outports, Net	23	7	6	to	23	10	0	per ton
Blende of 50 % Net	6	11	6	to	6	15	0	,,
Calamine, Net	6	14	0	to	6	15	0	,,

LEAD.

	£	s.	d.		£	s.	d.	
English Pig, Warehouse, Dis. 2½%	12	15	0	to	12	17	6	per ton
Spanish, ex ship, Dis. 2½%	12	8	9	to	12	10	0	,,
Lead Ore of 70 %, Net	6	2	6	to	—			,,

ANTIMONY.

	£	s.	d.		£	s.	d.	
Star Regulus, f.o.b., Dis. 2½ %	35	0	0	to	36	0	0	per ton
Ore, 50 %, ex ship, Dis. 2½%	8	10	0	to	9	10	0	,,
Crude, ex ship, Dis. 2½ %	15	0	0	to	17	10	0	,,

QUICKSILVER.

	£	s.	d.
Spanish, 75 lb., Warehouse, Net	7	12	
Italian ,, ,, ,,	7	11	

COAL.

LEICESTERSHIRE.

The Nailstone Colliery Company, Leicester, quote. Price per Ton at Pit of 20 Cwt., with ½ Cwt. per Ton for wastage —

Upper Main Seam.	s.	d.
Main Coal	7	6
Best Hard Steam (hand picked, as used by the Railway Companies)	6	0
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)	6	0
Fine Slack	0	6

Terms, net cash on 10th of month following delivery.

DERBYSHIRE.

The Manners Colliery Co., Ltd., of Ilkeston quote as follows, per ton at pit:

Kilburn Coal:	s.	d.
Best London Brights	9	9
Large Nuts (1½ to 3½)	9	6
Small Nuts (¾ to 1½)	6	0
Rough Brights	6	0
Peas (⅜ to ¾)	5	0
Slack	3	6
Smudge	2	0

Low Main (or Tupton) Coal:		
Low Main Brights	7	6
,, ,, Nuts	7	3
Hards (Good Steam Coal)	8	0
Bakers' Nuts (1" to 2")	6	6
Slack	3	6

The Clay Cross Company's Collieries, Clay Cross, near Chesterfield, quote:—

	per ton at pit. s.	d.
Best Main Coal	10	6
Best Silkstone	10	0
Best House Coal	8	6
Best House Nuts	8	0
Treble Screened Cobbles	7	9
Best Cobbles	7	3

NOTTINGHAMSHIRE.

The Digby Colliery Co., Ltd., near Nottingham, quote per ton at pit:—

Digby Coal:

STEAM.	s.	d.
Best Hand Picked Hard	9	0
Steam Hard	7	9
Hard Nuts	7	0

Gedling Colliery.

HIGH HAZEL.		
London Brights, 4 to 8 in. cube	12	0
Large Nuts, 2 to 4 in. cube	9	6
Small Nuts, ¾ to 2 in. cube	5	6

STEAM.—TOP HARD.		
Best Hard	9	0
Hard Steam	8	0
Cobbles	7	0

CHEMICALS AND OILS.

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square, Manchester, quote:

		£	s.	d.	
Acids:	Oxalic	0	0	2⅛	per lb.
	Picric, Crystals	0	0	11	,,
	Tartaric at Manchester	0	0	10⅞	,,

		£	s.	d.	
Acetate of Lime:	Brown at Manchester net	9	10	0	per ton.
	Grey ,,	11	10	0	,,
Alumina:	Alum, Lump, loose	5	5	0	,,
	,, ,, in casks	5	7	6	,,
	,, Ground, in bags	5	15	0	,,
	Sulphate of Alumina, 14%	4	10	0	,,
Ammonia:	Carbonate	0	0	3⅝	per lb.
	Muriate Grey f.o.b. Liverpool	24	0	0	per ton.
	Sal-ammoniac, Lump, 1sts, del^d. U.K.	42	0	0	,,
	,, ,, 2nds, ,,	40	0	0	,,
	Sulphate f.o.b. Liverpool	12	15	0	,,
Arsenic:	Best White Powdered net	12	7	6	,,
Bleaching Powder, 35%	,,	4	10	0	,,
Borax:	British Refined Crystal ,,	12	0	0	,,

Coal Tar Products:		£	s.	d.	
Benzole, 50/90 %	,,	0	0	6	per gal.
,, 90%	,,	0	0	7	,,
Carbolic Acid Crystals, 34/35° C.	,,	0	0	6	per lb.
,, ,, ,, 39/40° C.	,,	0	0	6¼	,,
,, ,, Liquid, 97/99 %	,,	0	0	9	per gal.
,, ,, Crude, 62½ % at 60° F. f.o.b.	,,	0	1	9	,,
Creosote, ordinary good liquid	,,	0	0	1⅝	,,
Naphtha, Crude, 20 % at 120° C.	,,	0	0	3	,,
,, Solvent, 90% at 160° C. f.o.b	,,	0	0	8	,,
,, ,, 95 % at 160° C. ,,	,,	0	0	9	,,
,, ,, 90 % at 190° C. ,,	,,	0	0	10	,,
,, Rectified, flash point over 73° F. f.o.b.	,,	0	0	11	,,
,, Rectified, flash point over 100° F. f.o.b.	,,		1	0	,,
Naphthalene, all qualities.					
Pitch f.a.s. Manchester.	,,	1	11	6	per ton.

		£	s.	d.	
Copperas:	Green, in bulk ,,	0	12	6	,,
	,, barrels f.o.b. L'pool ,,	1	19	0	,,
	Cake ,,	1	2	6	,,
Copper:	Sulphate	22	0	0	,,
Cyanides:	98% minimum f.o.b. net	0	0	7½	per lb.
Lead:	Acetate (Sugar) White, English	27	10	0	per ton.
	,, ,, ,, Foreign c.i.f. U.K	24	5	0	,,
	,, ,, Grey	21	15	0	,,
	,, ,, Brown at Manchester	17	0	0	,,
	Nitrate	24	0	0	,,
	Litharge, Flake	15	10	0	,,
	,, Powder	16	0	0	,,
	Red Lead, Genuine, c.i.f. London less 5%	15	10	0	,,
	White ,, ,, Dry ,, ,, ,,	16	15	0	,,
Naphtha (Wood):	Miscible, 60 o.p.	0	2	10	per gal.
	Solvent	0	2	7	,,
Potash:	Bichromate... delivered England	0	0	3	per lb.
	Carbonate, 90/92 % ... c.i.f Hull	18	10	0	per ton.
	Caustic, 75/80 % ,, ,,	20	15	0	,,
	Chlorate net	0	0	3$\frac{1}{16}$	per lb.
	Montreal in Store, Liverpool	35	0	0	per ton.
	Prussiate, Yellow net	0	0	5	per lb.

		£	s.	d.	
Soda:	Ash, Caustic, 48 %, Ordinary .. net	5	5	0	per ton.
	,, ,, ,, Refined...... ,,	6	5	0	,,
	,, Carbonated, 48 %............ ,,	5	10	0	,,
	,, ,, 58 % (Ammonia Alkali) ....net	4	10	0	,,
	,, Bleachers' Refined Caustic 50/52 % .... net	6	10	0	,,
	Caustic, White, 77 %............... ,,	10	10	0	,,
	,, ,, 70 %............... ,,	9	12	6	,,
	,, ,, 60 %.. .... ,,	8	12	6	,,
	,, Cream, 60 %..... ....,	8	10	0	,,
	Crystals, in bags	3	0	0	,,
	,, barrels	3	7	6	,,
	Acetate .... c.i.f. Hull net	17	10	0	,,
	Bicarbonate, in 1 cwt. kegs............	6	15	0	,,
	Bichromate......delivered England...	0	0	2¼	per lb.
	Chlorate .... net	0	0	3 1/16	per lb.
	Nitrate...ex quay Liverpool, ... ,,	11	7	6	per ton.
	Phosphate	9	5	0	,,
	Prussiate ....net	0	0	3⅝	per lb.
	Silicate, Solution, 140° Tw.	4	10	0	per ton.
	Sulphate (Glauber Salts)................	1	12	6	,,
	,, (Saltcake, 95%)...............	1	15	0	,,
Sulphur:	Recovered	4	15	0	,,
	Roll	6	15	0	,,
	Flowers..............................	7	10	0	,,
Zinc:	Sulphate	6	15	0	,,

MINERALS.

		£	s.	d.	
Barytes:	Lump Carbonate, 90/92%	3	10	0	per ton.
	Sulphate, No. 1, White	2	15	0	,,
China Clay:	of various qualities for all purposes; prices from about 11/- to about 30/- per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid.				
Chrome Ore:	Basis 50% c.i.f. British Ports..........	3	7	6	,,
Manganese:	Lump c.i.f. Liverpool 10¼d.	per metallic unit.			
Ochre:	French JC .... f.o.b. Rouen, net	2	5	0	per ton.
	,, JF	5	10	0	,,
Talc:	(French Chalk).........c.i.f. Liverpool	3	10	0	,,

OILS, etc.

		£	s.	d.	
Aniline Oil	....................................net	0	0	4¾	per lb.
,, **Salt**	.... ,,	0	0	4½	,,
Castor Oil:	French, 1st pressure, f.o.b. Marseilles less 1¼%.........	22	15	0	per ton.
	English, 1st pressure, f.o.r. Hull, less 2½%...............	23	5	0	,,
Cocoa Nut Oil:	Ceylon, ex store Manchester..............net	29	10	0	,,
	Cochin, ex store Manchester.. ....net	32	0	0	,,
Cotton Seed Oil:	Refined at Hull, less 2½% naked	13	15	0	,,
	Edible...at Hull, less 2½% naked	14	5	0	,,
Glycerine:	Crude, 80% .... net	31	0	0	,,
Linseed Oil:	Raw... ..at Hull, less 2½% naked	14	5	0	,,
	Boiled......at Hull less 2½% naked	15	5	0	,,
Starch:	American Pearl...at Manchester, net	8	15	0	,,
	Dextrine........... ,, ,,	17	15	0	,,
	Farina............... ,, ,,	15	0	0	,,
ellac:	Standard TN orange spot	147/-			per cwt.
rpentine:	American.........at Liverpool	38	0	0	per ton.
	Russian ....at Hull...net	19	0	0	,,

TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote:—

COLONIAL WOODS.

Timber.

		£	s.	d.		£	s.	d.
Quebec Square White Pine...	per cub. ft.	0	1	9	to	0	3	0
Quebec Waney Board Pine...	,,	0	2	8		0	3	9
St. John Pine, 18 in. average	,,	0	2	4		0	3	3
Lower Ports Pine..............	,,	0	1	3		0	1	8
Quebec Red Pine	,,	0	1	6		0	2	0
Quebec Oak, 1st quality	,,	0	2	9		0	3	4
Quebec Oak, 2nd quality ...	,,	0	1	6		0	2	6
Ash	,,	0	1	6		0	2	3
Elm	,,	0	3	3		0	3	10
Hickory	,,	0	2	0		0	2	6
Quebec Birch	,,	0	1	6		0	2	3
St. John Birch	,,	0	1	6		0	2	0
Birch Planks......................	,,	0	0	9		0	0	11
Spruce Spars	,,	0	0	10		0	1	0

Deals.

		£	s.	d.		£	s.	d.
1st quality Quebec Pine	per std.	22	10	0	to	32	10	0
2nd do. do.	,,	17	0	0		22	0	0
3rd do. do	,,	11	10	0		13	0	0
St. John, N.B., etc., Spruce	,,	6	15	0		7	5	0
Lower Ports Spruce..	,,	6	10	0		6	15	0
Spruce Boards................	,,	5	10	0		6	0	0

UNITED STATES, etc., WOODS.

Pitch Pine.

		£	s.	d.		£	s.	d.
Hewn	per cub. ft.	0	1	4	to	0	1	8
Sawn	,,	0	0	11		0	1	6
Planks, Stowage	,,	0	0	10		0	1	0
Boards, Prime	per std.	12	10	0		16	0	0
Oak Timber	per cub. ft.	0	1	6		0	2	6
Oak Planks	,,	0	1	6		0	2	1
East India Teak.............	per load	12	0	0		16	0	0
Greenheart.....	,,	6	15	0		7	10	0

EUROPEAN WOODS.

Timber.

		£	s.	d.		£	s.	d.
Riga Redwood	per cub. ft.	0	1	6	to	0	2	0
Dantzic and Memel Fir, Crown	,,	0	2	1		0	2	6
Dantzic and Memel Fir, Middling	,,	0	1	9		0	1	11
Stettin	,,	0	1	9		0	1	11
Swedish	,,	0	1	0		0	1	3
Riga Whitewood	,,	0	1	0		0	1	3
Norway Mining Timber	,,	0	0	9		0	1	0
Dantzic and Stettin, etc., Oak..	,,	0	2	6		0	3	0
Norway Spars................	,,	0	1	2		0	1	9

Deals.

		£	s.	d.		£	s.	d.
Red Archangel and Onega, 1st quality	per std.	19	0	0		20	0	0
Red Archangel and Onega, 2nd quality	,,	14	0	0		16	0	0
Red Archangel and Onega, 3rd quality	,,	10	10	0		12	10	0
St. Petersburg, 1st quality...	,,	16	0	0		17	10	0
Do. 2nd ,, ...	,,	14	0	0		15	0	0
Gefle	,,	11	10	0		16	0	
Wyburg	,,	11	0	0		12	10	
Uleaborg	,,	10	0	0		12	10	
Gothenburg	,,	11	0	0		16	0	

SELECTED PATENTS.

Compiled expressly for this journal by **Messrs. Page and Rowlingson, Engineering Patent Agents, 28, New Bridge Street, London, E.C.,** and at Manchester.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton Buildings, Chancery Lane, W.C., at the uniform price of 8d.

NEW PATENTS APPLIED FOR.

When Patents have been communicated the names of the communicators are printed in *italics*.

4581. A. M. Todd and E. Williams, North Wales. Mar. 6th.—Improvements in stop valves and the like.

4589. H. Monk, Chester. Mar. 6th.—Improvements in epicyclic gearing.

4595. T. R. Charlton and G. H. Tarver, Newcastle. Mar. 6th.—Improvements in stopping and starting hydraulic pumps, electrically driven or otherwise.

4596. L. Carr, New Cleethorpes. Mar. 6th. A double-shackle swivel.

4598. D. F. Taylor and Co., Ltd., and F. Carter, Birmingham. Mar. 6th.—Improvements in ties or connections for driving belts, bands and ropes.

4599. H. Skelton, Stockton-on-Tees. Mar. 6th. —Improved means or apparatus for flushing sewers, also adapted for drawing off storm water.

4603. L. Wilson, Scotland. Mar. 6th.—Improvements in elastic fluid motors (turbines).

4604. L. F. Massey and H. F. Massey, Manchester. Mar. 6th.—Improvements in pneumatic power hammers.

4606. J. Baeder, Germany. Mar. 6th.—Improvements in change speed stop gears.

4609. E. Lange, Germany. Mar. 6th.—Improvements in rotary engines.

4615. G. McGhee, Glasgow. Mar. 6th — Improved variable speed and reversing gear.

4620. F. B. Wells, London. Mar. 6th.—Improved drilling appliance adapted for use in substitution for a ratchet brace.

4623. W. Anstey, Charlton. Mar. 6th. A mixing valve for supplying cold, tepid or hot water to baths or other receptable.

4633. O. O. Storle, London. Mar. 6th — Improvements in or relating to valves.

4645. R. M. Deeley, London, Mar. 6th.—Improvements relating to the working of compound engines and in regulator valves therefor.

4653. J. Cowan, London. Mar. 6th.—Improvements relating to separately fired superheaters.

4656. J. E. Mathewson, London. Mar. 6th. —Improvements in apparatus for drying sand moulds in foundries.

4657. N. J. Hennemann, London. Mar. 6th.—Improvements in and relating to supplying and controlling the feed-water of steam generators.

4659. E. J. Mead, London. Mar. 6th.—Improvements in and connected with rotary pumps.

4674. H. E. Newton, London. Mar. 6th.—Improvements in centrifugal, turbine and similar pumps. (*H. R. Worthington, U.S.A.*)

4692. H. B. Barlow, Manchester. Mar. 7th. —Improvements in steam and other fluid pressure regulators. (*Foster Engineering Company, U.S.A.*)

4707. H. T. Boothroyd, Liverpool. Mar. 7th.—Improvements in portable drilling apparatus.

4712. D. F. Stayman and G. T. Phillips, London. Mar. 7th.—Improvements in pistons and piston valves.

4718. A. B. Snell and G. Candelet, London. Mar. 7th.—Improvements in and relating to the construction of ships' hulls.

4721. C. von Bergmann, Germany. Mar. 7th.—Improvements in and relating to self-acting boiler-feeders.

4749. A. P. Filippi, London. Mar. 7th.—Improvements in propellers. (Date applied for Mar. 7th, 1904.)

4784. W. A. P. Werner, London. Mar. 7th. —Improvements in and relating to steam generators and in and relating to burners more especially applicable to steam generators.

4785. W. A. P. Werner, London. Mar. 7th. —Improvements in and relating to automatically operating mechanism for the regulation of the feed-water supply to steam generators and the like.

4789. J. Douglas, London. Mar. 7th.—Improvements in reversible and feathering screw propellers

4804. R. R. Neilson, Glasgow. Mar. 8th.—Improvements in steam generators.

4840. J. Noad, London. Mar. 8th.—Improvements in the manufacture of metallic hollow cylindrical or tubular bodies.

4844. J. W. Haywood, Leeds. Mar. 8th.—Mechanical enclosed airtight damper for boilers and chimneys.

4871. W. O. Wood, London. Mar. 8th.—Improvements relating to the sinking of shafts or the formation of tunnels in aqueous strata and similar unstable material.

4886. De Courcy Beamish, Liverpool. Mar. 8th.—Improvements in or in connection with the steering of ships.

4892. H. Chitty, London. Mar. 8th.—Improvements relating to power generators.

4910. S. B Halcomb, P. MacGregor and J. F. Bennett, Sheffield. Mar. 9th.—Improvements in the treatment of metals for rolling drawing and other purposes.

4919. H. Cottrell and J. Adkins, Hanley. Mar. 9th.—Combined flue chimney top (to prevent down draught).

4924. J. E. Preston, London. Mar. 9th.—Improved rotary engine pump or compressor.

4929. J. H. Lawrence, Neath. Mar. 9th.—Graduated adjustable ball valve arrangement for flushing cisterns and water tanks (to regulate supply and prevent overflows).

4932. J. Redman, T. Redman and E. S. Redman, Halifax. Mar. 9.—An appliance for transferring a driving belt from one pulley on a speed cone to any other pulley on same cone.

4940. C. B. Rearick, London. Mar. 9th.—Improvements in and relating to steam generators.

4943. T. J. Ridge, London. Mar. 9th.—Improvements in differential gear.

4946. A. Wilkins, Dovercourt. Mar. 9th.—Improved screw propeller.

4961. W. Rowland, London. Mar. 9th.—Improvements in valve and reversing gear for steam engines and the like.

4962. W. Rowland, London. Mar. 9th.—Improvements in valve and reversing gear for steam engines and the like.

4986. A. C. Potter, London. Mar. 9th.—Improvements in and relating to means for ascertaining the depth from the surface of water in well borings and for similar purposes.

4991. A. B. Chatwood, Manchester. Mar. 10th.—Improvements in steam engine valves.

4992. T. H. Barton, Little Eaton. Mar. 10th.—An internally and centrally acting double expanding friction clutch for clutching the driving toothed wheels, chain wheels, belt pulleys and the like used in motors, bicycles or general machinery.

4997. J. Carr, Glasgow. Mar. 10th.—Improved means for obtaining motive power.

4999. C. M. McNamara, Glasgow. Mar. 10th.—Improvements relating to covered tipping dust and other carts.

5004. J. H. Boylan, Manchester. Mar. 10th—Improvements in tubes for steam generators and steam superheaters and feed-water heaters.

5009. J. R. Drysdale, Newcastle. Mar. 10th.—Automatic motion.

5011. J. N. Kay, Bury. Mar. 10th.—Improvements in friction clutches for transmitting power.

5021. R. R. Rook, Chapeltown. Mar. 10th—Improvements in means or apparatus for propelling vessels.

5031. E. Brinham, Stockton-on-Tees. Mar 10th.—An improved mechanical and automatic arrangement for working the warping gear of steam trawling and other winches.

5037. P. W. Noble, Coventry. Mar. 10th,—Improvements in or relating to fluid pressure engines.

5041. T. H. Stringer and A. Liwentaal, London. Mar. 10th.—Improvements in and relating to motor launches and other navigable vessels.

5043. J. E. Tolson, London. Mar. 10th.—Improvements in rotary engines.

5044. J. E. Tolson, London. Mar. 10th.—Improvements in or relating to steam generators.

5052. W. Reuter, London. Mar. 10th.—Trough-charging travelling crane for Siemens-Martin furnaces.

5055. C. H. T. Alston, London. Mar. 10th.—An improved mechanical device for transmitting, retarding or accelerating, stopping and reversing the motion of shafts.

5064. W. P. Reynolds, London. Mar. 10th.—Improvements in and relating to reversing valve gear.

5065. J. D. Loppentien, London. Mar. 10th.—Improvements in and relating to power-transmitting devices.

5074. J. M. Stratton, London. Mar. 10th.—Improvements in or connected with the furnaces of steam boilers.

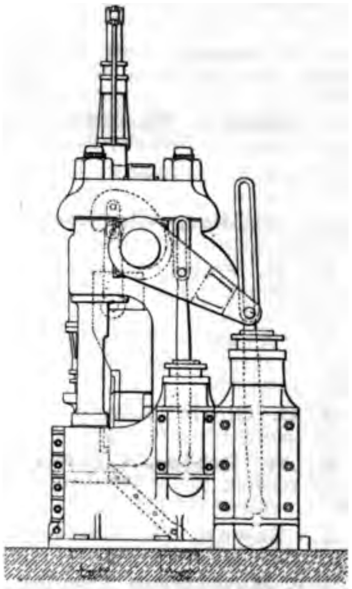
5083. A. Elgar, London. Mar. 10th.—Improvements in and connected with submarine torpedo-boats.

5098. P. S. Swan, Glasgow. Mar. 11th.—Improvements in flues or furnaces for steam boilers.

RECENT SPECIFICATIONS.

HYDRAULIC SHEARING PUNCHING AND FORGING MACHINES.

A. Lamberton, of Coatbridge. April 8th 1904.—Relates to hydraulic shearing, punching, forging, and the like machines, in which, as hitherto generally constructed, the power used to perform a working stroke is constant with different dimensions of work operated on, so that when work lighter than the maximum capacity of the machine is being operated upon there is a considerable waste of power; and this invention has for its object to construct machines such that the power used may be proportioned to the work operated upon and in which, at the same time, there are no frictional losses due to the movements of idle parts when the machines are working below their maximum power. The essence



of the invention is the use, in shearing, punching, forging or similar machines, of a number of hydraulic operating rams any one of which, or a group of any two or more of which, may be utilised to operate the machine with power proportionate to the work to be done, while those not so used remain at rest, and the invention may be applied to machines other than that hereinbefore described by way of example, and in a manner differing therefrom without departing from its spirit; for example, any number of rams may be provided, and the means for permitting the non-operating rams to remain at rest may be of any convenient form.

STEAM SUPERHEATERS.

F. Hargreaves and J. G. Hudson, of Bolton. April 9th, 1904.—This invention relates to superheaters for steam, and has for its object by an improved combination and arrangement of parts to provide a superheater, which is of simple construction, easy to assemble, and readily accessible for overhaul or repair. According to one construction a straight inlet and a straight outlet header is provided, which may be either circular or of other convenient form in cross section, which are preferably formed with cylindrical parts at their ends. To these cylindrical parts are secured, by a single long bolt passing through the header, a right-angled outlet or inlet flanged branch pipe at the one end, and a blind flange at the other end; the outlet and inlet branches being thus capable of swivelling on the ends of the headers, so that the connection with the headers may be angled through a considerable arc. A series of external bolts extending from end to end of the headers, and passing through flanges on the inlet and outlet branches, or also on the headers may be provided to additionally secure the parts together, or in place of the internal bolts. The two headers are arranged side by side with the inlet branch of the inlet header at the opposite end from the outlet branch of the outlet header, and from the headers there depends a series of more or less U-shaped tubes, the ends of the tubes being so set as to be radial to the points on the headers where they are entered. The ends of these tubes are expanded into a series of holes in each header; successive holes in each header being arranged on opposite sides of the centre of the bottom of the header, and pairs of holes in each header at the same side of the centre line being connected by each U-tube, so that the row of tubes when assembled are staggered, and so present a larger unobstructed surface to the hot gases, and offer more obstruction to their passage.

FIG.1.

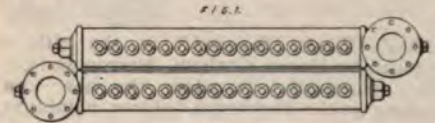


FIG.2

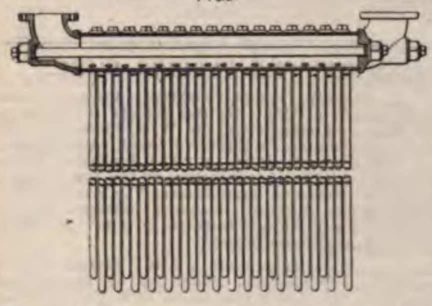
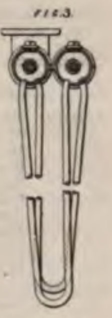


FIG.3



RAILWAY BUFFING AND DRAW GEAR.

G. Westinghouse, of Pennsylvania, U.S.A. Jan. 8th 1904 (date claimed under International Convention).—This invention relates in general to combined spring and friction devices for yieldingly resisting strains and gradually absorbing shocks, and more particularly to that class of these appliances used as draw gear and buffing apparatus for railway cars. The principal object of this invention is to simplify such apparatus as is already in use by dispensing with certain parts, such as the rigid casing and the preliminary spring, and to provide a device in which the main resistance spring itself acts as a casing for holding the enclosed friction members against transverse movement, thereby reducing the number of necessary parts and the cost of manufacture, while at the same time providing a compact, durable and efficient apparatus. Several different forms of gear are described and illustrated, and claim is made to the following: a draw gear or buffing apparatus comprising friction members having longitudinal frictional surfaces, a helical resistance spring surrounding the said friction members and forming a casing therefor, and a wedging device for forcing the members into frictional engagement.

Fig.1

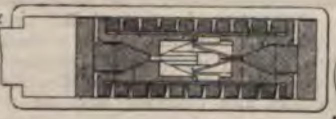


Fig.2

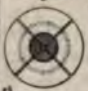


Fig.3

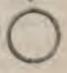
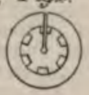


Fig.5



NEW DOCK FACILITIES.

As to the extensive system of wharves which has just been sanctioned by the Thames Conservancy Board, the Railway News states that this scheme has been originated by Mr. Ernest Forwood, a well-known shipowner. It appears that the wharf will be situated about midway along Long Reach, eighteen miles from London by rail and six miles above Gravesend, on a stretch of river about four miles in length, where the course of it is straight, and where there is ample water. The wharf is to be 6,600 ft., or 440 yards over a mile in length, and will be able to deal with six million tons of goods a year, and no less than twenty ships of 300 ft. long, and drawing any depth of water up to 30 ft., will be able to lie alongside at one time, while a hundred barges can have cargo transferred to them simultaneously. Between the embankment and the wharf there will be a large area of sheltered water in which barges can lie and be loaded either from the transport sheds, or from the vessels direct, long-armed cranes on the wharf lifting goods straight out of the holds of ships on the river side and depositing them in barges on the land side.

NEW PUBLICATIONS.

"MANUAL OF ELECTRICAL UNDERTAKINGS AND DIRECTORY OF OFFICIALS, 1905."

Compiled under the direction of Emile Garcke. Electrical Press, Ltd. 15s. net.

This indispensable auxiliary has how reached its ninth year of publication, and although the electrical industries were by no means exempt from last year's general depression in trade, the manual now before us shows a decided increase in bulk, which seems to reflect increasing activities in the various fields of electrical engineering. The arrangement of the statistics and other matter remains substantially in the same convenient form familiar to those who have used the preceding volumes. The general information is classified as follows: Electric Lighting, Power and Traction; Telegraph and Telephone; Manufacturing and Miscellaneous; Directory of Directors and Officials; and list of other electrical companies registered since 1856. All electrical companies and municipal electrical undertakings are included in these sections. Taking the returns as a whole, we find that they reveal the effects of the trade conditions from which no industry seems to have been exempt. An exception has to be made in the case of telegraphs and telephones, as in the one case the business is world-wide and less susceptible to local influences, while the telephone business in this country has a special vitality which effects steady progress while manufacturing and kindred interests are fluctuating. Thus the average return on the telegraph companies is 5·19 per cent., while in the previous volume the corresponding figure stood at 4·76 per cent. The telephone rate has likewise risen from 4·80 to 4·88 per cent.

In addition to the data regarding each undertaking, there is a section devoted to the chief electrical events of the past year, including the Royal Commission on London Locomotion, Tramway Running Powers, Electrification of Steam Railways, the Wireless Telegraphy Act and the agreement between the Marconi Companies and the Post Office, Municipal Telephones, the Supply of Electricity Bill, and the London Electric Lighting Areas Act. Other special contents of the "Manual" repeated in up-to-date form are the lists of highest and lowest prices of electrical investments, lists of all electrical railways, tramways, and light railways, and the elaborate schedule, now enlarged, which gives a complete analysis of the revenue accounts of electric supply undertakings. Although we cannot call attention to all the admirable features of the volume, mention must be made of the many valuable maps, which give a comprehensive idea of the progress of electric traction.

"THE ELEMENTS OF RAILWAY ECONOMICS."

By W. M. Acworth. The Clarendon Press. 2s. net.

The object of this book, the author tells us, is to consider railways and railway business from the economic point of view. The need of such a work has often been felt, and it is a pity that Mr. Acworth, who has lectured on this subject for several years at the London School of Economics, has not carried out his work with a nearer approach to completeness; but his idea seems to have been that half a loaf is better than no bread; as he is eminently fitted for the authorship of a volume of greater utility, we shall look forward to its publication with much interest. The student, however, will no doubt find this little work very helpful. After a brief sketch of railway development, the writer discusses railway capital and expenditure, the maintenance of way, rolling stock and traffic, methods of charging, classification and rates and the interference of Parliament.

BOOKS RECEIVED.

"The Investigations of Mine Air: an account, by several authors, of the nature, significance, and practical methods of measurement of the impurities met with in the air of Collieries and Metalliferous Mines." Edited by Sir Clement Le Neve Foster, D.Sc F.R.S., and J. S. Haldane, M.D., F.R.S. 6s. net.

"Applied Mechanics and Mechanical Engineering." By Andrew Jamieson, M.Inst.C.E. Charles Griffin and Co. 12s. 6d.

"Journal of the Institution of Electrical Engineers, including original communications on Telegraphy and Electrical Science." Edited by George C. Lloyd. E. and F. N. Spon. 5s.

"A Classbook of Naval Architecture." By W. J. Lovett. Longmans, Green and Co. 7s. 6d. net.

"Fire Tests with Glass: Electro-Glazed Casements." The British Fire Prevention Committee. 2s. 6d.

"Steam Turbines, with an appendix on Gas Turbines and the Future of Heat Engines." By Dr. A. Stodold, translated by Dr. Louis C Loewenstein. Archibald Constable. 21s. net.

NEW CATALOGUES.

A very attractive Pamphlet, has been issued by Messrs. Ed. Bennis and Co., Ltd., on the "Bennis" Stoker and Compressed Air Furnace. The raison d'être of the pamphlet is summed up in the words, "Cheap Steam," which appear in metallic embossed lettering on the green cover. The details of the Bennis system are very carefully explained, and there are numerous illustrations, the most important being a double page view showing photo of Bennis Patent Stoking and complete Coal and Ash Elevating and Conveying Plant as fitted to eighteen boilers at the Carlton Main Colliery Company's (Ltd.) Grimethorpe Colliery, near Barnsley.

"The Britisher's Black Diamond" is the title of a booklet issued by Messrs. Graham, Morton and Co., Ltd., which pictorially describes the new coal screening plant at the Thrybergh Colliery, Kilnhurst, an account of which recently appeared in PAGE'S WEEKLY.

MEETINGS FOR THE ENSUING WEEK.

FRIDAY, MAR. 24.—Physical Society, University College, Gower Street, 5 p.m.: 1. "Note on the Voltage Ratios of an Inverted Rotary Converter," by Mr. W. G. Clinton. 2. "On the Flux of Light from the Electric Arc with varying Power Supply," by Mr. G. B. Dyke. 3. "The Application of the Cymometer and the Determination of the Coefficient of Coupling of Oscillation Transformers," by Professor J. A. Fleming, F.R.S.—Electro Harmonic Smoker, Holborn Restaurant, 8 p.m.—Royal Institute, 9 p.m.: Sir Oliver Lodge, "A Pertinacious Current."

SATURDAY, MAR. 25.—Royal Institution, 3 p.m.: Professor J. J. Thompson on "Electrical Properties of Radio-Active Substances."—Manchester Association of Engineers, Grand Hotel, 7 p.m.: Paper, "Power Gas Plants and some of their uses; Mr. T. Rigby.

MONDAY, MAR. 27.—Royal Geographical Society, 8.30 p.m.: Sir Harry Johnston on "Liberia,"—Society of Arts, 8 p.m.: Mr. H. Laws Webb on "Telephony," Lecture III.—Institute of Marine Engineers, Stratford, 8 p.m.: "Fuel Testing."

TUESDAY, MAR. 28.—Royal United Service Institution, 3 p.m.: Lieut.-General Sir J. French presides at a lecture by Major the Hon. T. F. Fremantle: Paper, "Modern Military Rifles."—Royal Institution, 5 p.m.: Professor W. E. Dalby: Paper, "Engineering Problems."—Society of Arts, 4.30 p.m.: The Agent-General for Western Australia: Paper, "The Manufactures of Greater Britain: II., Australasia."—Institution of Electrical Engineers, Manchester Local Section: Paper, "Use of Electric Energy in Mines and Collieries," Mr. W. D. Mountain.—Institute of Civil Engineers, Great George Street, W. 8 p.m.

WEDNESDAY, MAR. 29.—Chemical Society: Annual General Meeting, 4.30 p.m.—Dundee Institute of Engineers: Annual General Meeting.

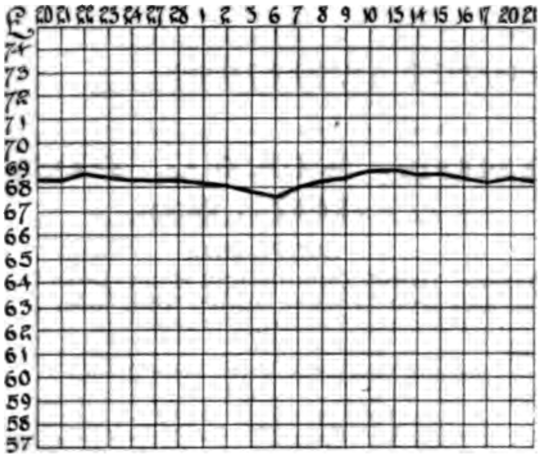
THURSDAY, MAR. 30—Royal Society, 4.30 p.m.—Civil and Mechanical Engineers, 8 p.m.

FRIDAY, MAR. 31.—Royal Institution, 9 p.m.

THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM FEBRUARY 20TH TO MARCH 21ST, 1905.

COPPER.



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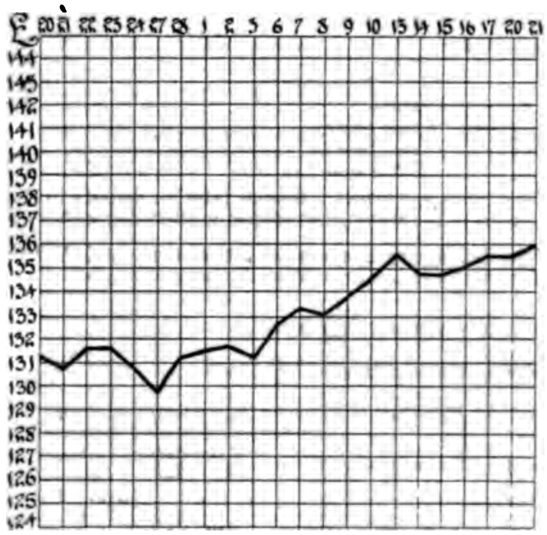

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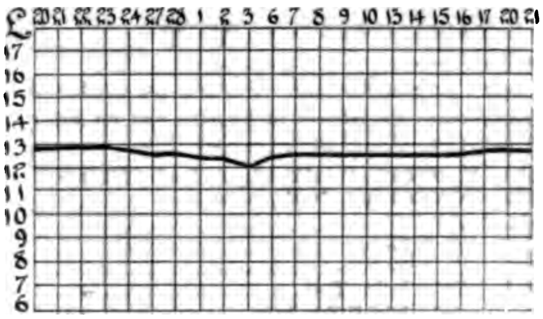
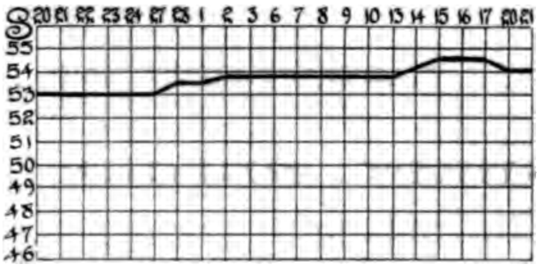


PIG IRON: SCOTCH,



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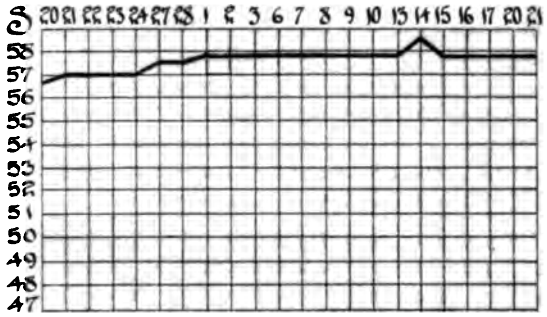
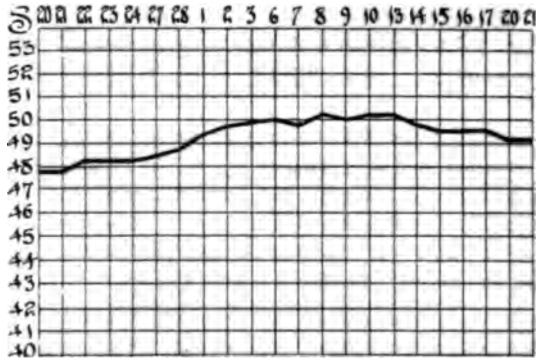


CLEVELAND.



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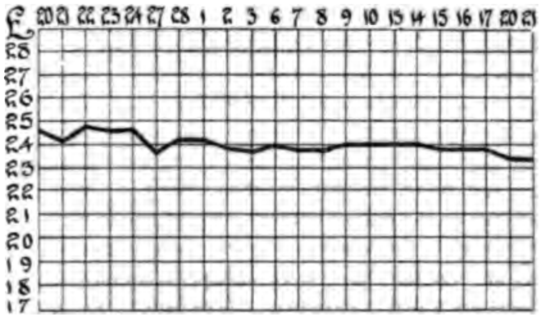


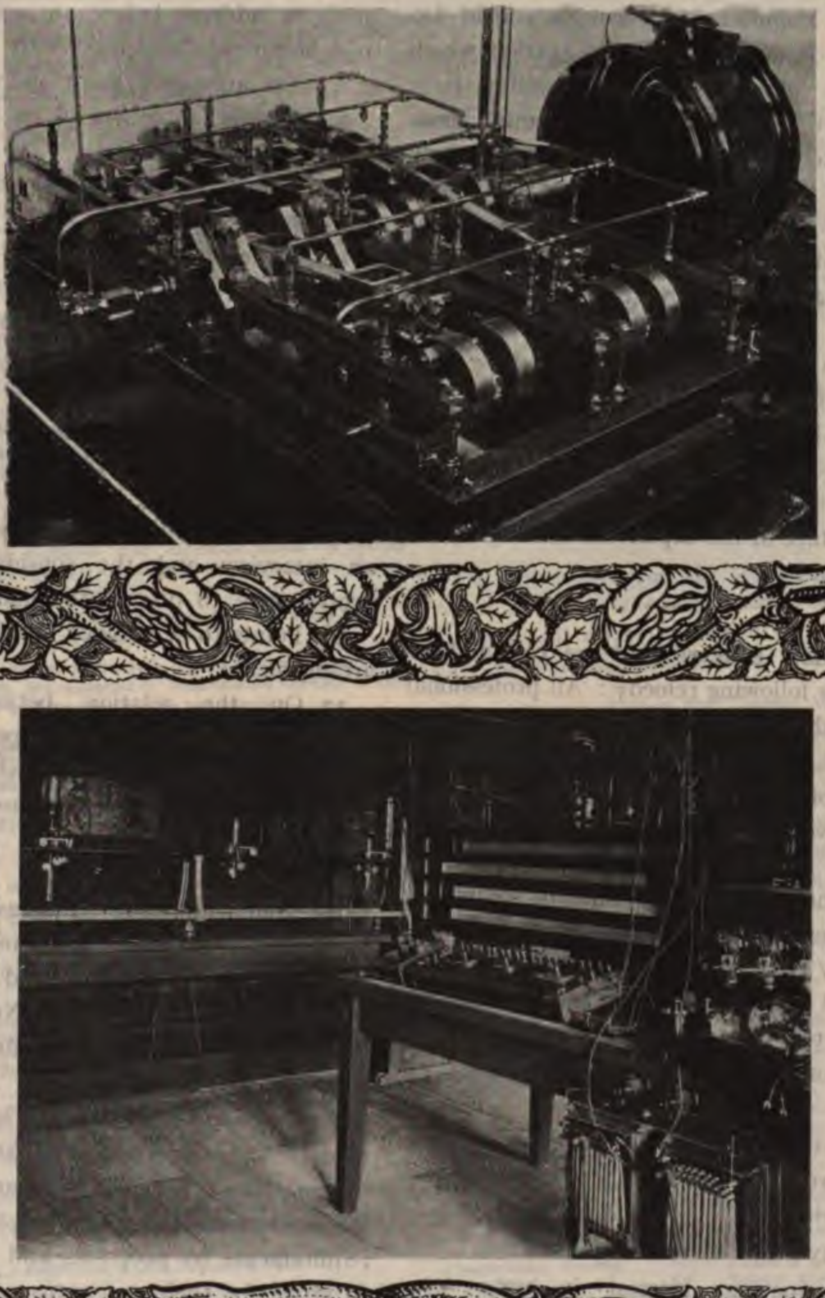
the employer looks with indifference upon a system of technical education which he plainly sees to be unproductive. The graduate of the engineering college or the diplomé of the polytechnic who has not been in the works is found to be of but little more value to an employer than a boy of the same age who has just left school.

In many cases continues the Professor, the pupils of our engineering colleges and technical schools acquire under existing methods a very small proportion of even the theoretical knowledge which it may have been attempted to impart. Their interest in the subject has not been aroused by preliminary observation in the workshops of the objects to be studied, and we do not find in them that keen desire to understand the principle of an appliance or the theory of a process which is manifested by those who have had to work them. Their studies appear to them a mere continuation of school work, and from long continuance too often become a weariness. Hence the cry for the lectures to be "made more interesting," and the cause of the absurd pop-gun element which so often makes its appearance on the lecture table.

Professor Nicolson will doubtless find many supporters when he proceeds to say that as a matter of fact the average youth from 16 to 19 years of age must be kept under discipline. He cannot be trusted to maintain a steady application to work if left alone. When following a course of study at this age he only learns as much of applied science or practical manipulation as the vigilance of the teacher or the system of checks to idleness compel him to do, so that any attempt to take up difficult because really useful work is a waste of time. If, on the other hand, he spends his time from 16 to 19 in the workshop he is much better employed. He is bound to work, whether he wishes to or not. He learns the elements of his profession by direct observation of practical methods and the actual handling of tools and machines, instead of having to picture them to himself from long descriptions and painful sketches. Professor Nicolson's experience is that, almost without exception, engineering students who have previously passed through practice become, at the end of their college course, men of the very highest industrial value.

It cannot surely be generally known, says Professor Nicolson in conclusion, that except by strenuous personal exertion, it is at present impossible to obtain this sequence of training, a sequence which is the only proper and sensible one. The employer, the educational authorities, and frequently even the teachers themselves all conspire to straiten the way leading to post-apprenticeship study. Employers naturally prefer men of 19 or 20 working in their shops for apprentices' wages to raw boys from school. The educational authorities know that if they do not get their pupil when he leaves school he will escape them altogether, and as, unfortunately, the teacher himself has often never been a practitioner and feels upon surer ground in dealing with ignorant schoolboys than with young men well versed in practical work, he also gives his vote in favour of the present system. Thus from a policy of expediency on the one hand and of self-interest or apathy on the other, our nonsensical system of "technical education" has grown up and now flourishes.

Mr. Swinburne has in a very interesting way shown the tendency of the business man in an engineering concern, to come out at the top, leaving the practical engineer in the middle and the pure scientist at the bottom. The commercial aspect of engineering is certainly a matter of very considerable importance, and therefore it may not be unprofitable to consider for a few moments the



AT THE NATIONAL PHYSICAL LABORATORY.
(1) Alternating Stress Testing Machine. (2) Photometric Equipment.

views held by our American friends on this subject. Mr. Charles A. S. Howlett raised the question at a recent meeting of the Western Society of Engineers and we have read his paper with interest, except the portion which lapses into psychology. This possibly is a pet subject of the author and may have crept in like King Charles's head, though how a study of the dual nature of the mind is to help one to sell say, planing machines. is not at first sight apparent. However, Mr. Howlett can be practical and accordingly he asks: Would not our engineering school training be much more complete and a great deal more beneficial if it embraced studies that would give us the benefit of the successful commercial side of the profession, as well as the purely engineering? Why cannot we be taught to take advantage of the experience of the successful salesman?

Mr. Howlett believes that we can and he suggests the following remedy: All professional schools, such as technical, medical, law, dental, agricultural, mining, pharmacy and the like. should incorporate in their senior year such studies as would develop the mind in a manner that would inspire in the student commercial instincts that would help him to profit by the experience of others in securing an opportunity to perform the work that his professional training enabled him to handle. In lieu of text books, lectures could be given in the senior year, on the following suggestions for topics:

1. "On the essentials to be kept in mind when approaching a stranger for a purely business interview."

2. "Many ways of securing attention."

3. "Arousing an interest in your proposition."

4. "Securing material for a persuasive talk."

5. "The elements of talking convincingly with logical expression."

6. "When to talk suggestively rather than argumentatively."

7. "On the elements of a successful impromptu address before an assemblage, such as a Municipal Council or State Board."

8. "On arguing a point successfully."

9. "On the admission of an interruption or an objection."

10. "The treatment and overcoming of self-assertion."

11. "The proper method of criticising competitor's arguments."

12. "Proper manner to assume in addressing the essentially serious and also the easy-going, pleasure-loving type."

13. "How to successfully create desire."

14. "Auto suggestion: its commercial possibilities."

15. Choosing the most successful time for an interview and the consideration of the proper time to discuss the matter of terms."

16. Points to be avoided in closing a business arrangement."

17. On the relation between character building and business-getting persuasion."

18. The influence of suggestion upon the human mind, with special reference to its commercial possibilities."

We commend these headings to Mr. Swinburne's attention. No. 18 seems to recommend a knowledge of hypnotism and we fancy that it might be safer to rely upon No. 4; otherwise there might be decided difficulties in the way of negotiations under No. 15. At the University of Illinois an endeavour is already being made to give practical suggestions in proper salesmanship. Specifications are prepared in the class-rooms and students asked to meet the requirements by proposals and to stand ready to argue for their apparatus, a particular type being assigned to each. The students are also encouraged to write the manufacturers for descriptive matter, stating exactly the use to which it is to be put.

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

DAVIDGE PAGE, Editor.

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MEETINGS FOR THE ENSUING WEEK.

FRIDAY, MARCH 31.—Royal Institution, Albemarle Street, W., 9 p.m.: Prof. Joseph Wright, "The Scientific Study of Dialects."—Mechanical Engineers, Storey's Gate, Westminster, S.W., 8 p.m.: Prof. David S. Capper, "First Report to the Steam Engine Research Committee" Discussion.

SATURDAY, APRIL 1.—Royal Institution, Albemarle Street, W., 3 p.m.: Lord Rayleigh, "Some Controverted Questions of Optics." (Lecture I.).—Birmingham Association of Mechanical Engineers.—Glasgow Technical College Scientific Society: Annual General Meeting.

MONDAY, APRIL 3.—Society of Engineers: Paper, "Statistics of British and American Rolling Stock." Mr. A. Pollard Digby.—Society of Arts: Cantor Lecture, "Telephony." Mr. H. Laws Webb.—Institute of Marine Engineers, Stratford. 8 p.m.

TUESDAY, APRIL 4.—Institution of Civil Engineers, 8 p.m.

WEDNESDAY, APRIL 5.—Society of Arts: Ordinary Meeting, 8 p.m.—Liverpool University Engieeering Society; Paper, "Sewerage and Sewage disposal: Mr. A. S. Mason.—Geological Society of London.

THURSDAY, APRIL 6.—Chemical Society, 8.30 p.m.—Royal Institution, 5 p.m—Civil and Mechanical Engineers, Caxton Hall, S.W., 8 p.m.—Institution of Electrical Engineers, 8 p.m.

FRIDAY, APRIL 7.—Royal Institution: "American Industry": Mr. Jas. Moseley.

NEWS ITEMS.

A communication of considerable importance on the 1905 Patent Rules appears on page 681.

The new Royal yacht, to succeed the *Osborne*, is to be built by Messrs. Inglis of Glasgow. She is to be 285 ft. in length, 40 ft. in breadth, and of 2,000 tons gross, and will be fitted with turbine machinery giving a speed of 17 knots.

Messrs. Howard Bros. have found it necessary to remove to larger premises at 40, Paradise Street, Liverpool. The London headquarters of the "Dey" Time Registers are at 100C, Queen Victoria Street, E.C.

Dr. J. S. Owens, B.A., M.Inst.C.E., F.R.G.S., and Mr. Gerald O. Case, son of the late Mr. Edward Case, inventor of the Case system of foreshore protection, have opened a new office at 15, Tothill Street, Westminster, S.W., where they are practising as sea defence engineers.

The Yost typewriter has been awarded the gold medal at the Capetown International Exhibition. This excellent machine has now a record of twenty-three gold medals standing to its credit.

It is announced that Mr. George Whale, the chief mechanical engineer of the L. and N.W.R., and other officials will visit America next week to attend the railway congress and inspect the great railroads of the States, with a view to seeing if there are improvements which can with advantage be adopted here. An article on American locomotive construction will be found on page 696.

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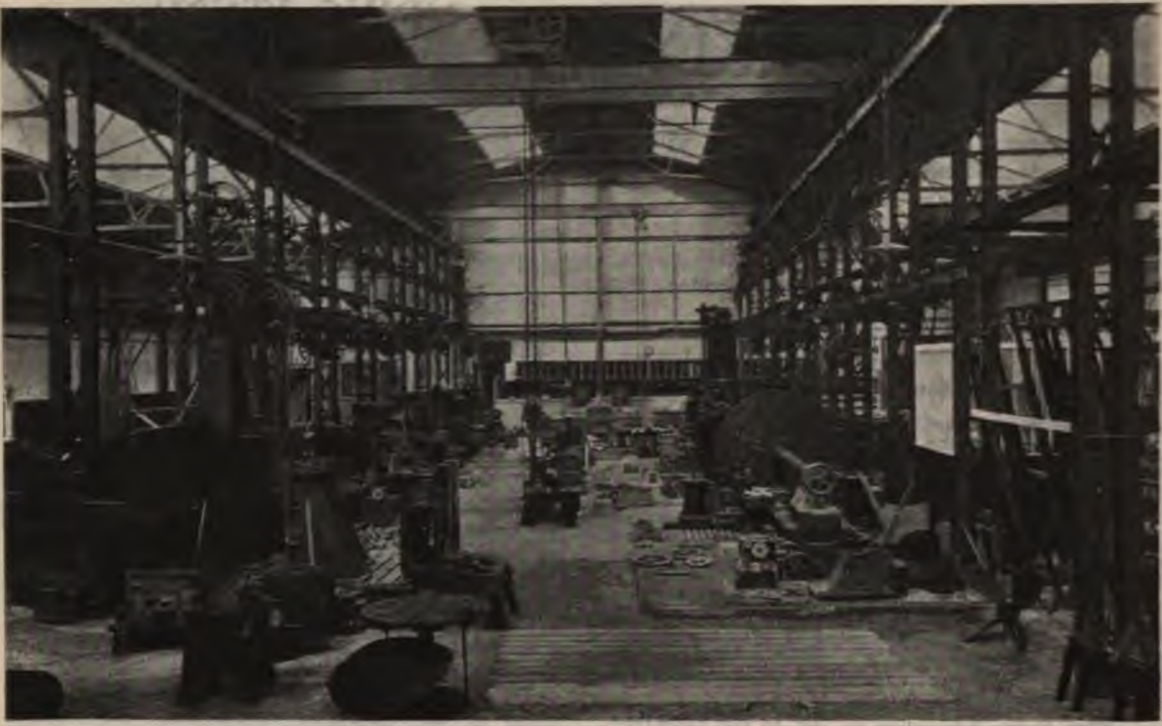
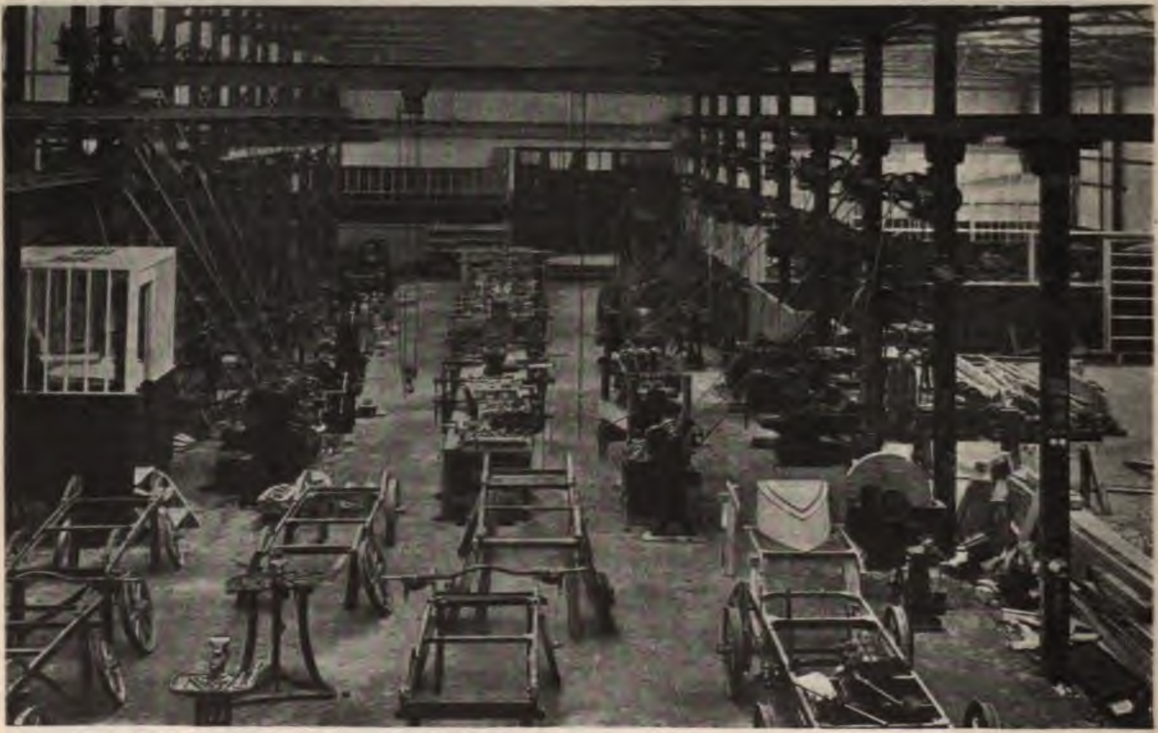


MAIN MARINE ERECTING BAY IN THE NEW WORKS OF THE VAUXHALL IRONWORKS COMPANY, LTD., AT LUTON.



ONE OF THE MOTOR BAYS.

The Vauxhall Ironworks Company, Ltd.—Opening of New Works.

In company with a large party of invited guests a representative of PAGE'S WEEKLY journeyed to Luton on Wednesday to be present at the opening of new works by the above company. The visit proved to be both interesting and instructive, and the guests were most hospitably entertained.

The new works are situated on the Midland main line, with a siding into the works at Luton, upon 6½ acres freehold. The present shops comprise four bays, each of 35 feet span, and are served throughout their length with overhead travellers, the main bay being 24 ft. to the underside of the crane from floor level.

The overhead travellers range from one ton to 12 tons, but provision has been made for serving the main marine erecting bay with a 20-ton traveller when required. Two bays are occupied by the old-established marine department of the business, and the machinery, etc., is ample for dealing with engines up to 1,000 horse-power. The main two bays are devoted to the more recent, but rapidly extending, motor work of the company.

A quantity of new plant has been installed, including a powerful "Massey" electrically-driven power hammer, gear-cutting machines, automatic turret machinery, etc.

Commodious offices, built in brick throughout, are placed across the end of the four bays, and comprise a large general office, drawing office, board room, a number of small offices, and lavatories. There is a gallery which gives a complete view over all the shops. A separate building, 90 ft. by 40 ft. span, is just being commenced to form the motor garage and testing department. A building is to be also shortly erected for the wood-work in connection with car bodies, upholstering and painting shop. The company has built a handsome house for the manager, two foremen's houses, caretaker's house, and a row of superior workmen's houses.

The whole of the machinery is driven by electric motors. Seven motors have been installed, driving line shafting, and in two instances independent motors have been provided for driving two large machine tools as independent units. The offices are lighted and heated throughout by electricity, the works being brilliantly illuminated with Lucas gas lights. A mess room, with gas cooker, has been provided for the use of the workmen.

The accompanying illustrations show the main marine erecting bay and one of the motor bays in the new works.

Holborn Electricity Exhibition.

The Holborn and Finsbury Electrical Exhibition is proving a great success. The daily attendance has been very good, and it is clear that the enterprise of the County of London Electric Supply Company in providing the exhibition is being properly recognised. The advantage of using electrical power is perhaps not so well appreciated as it should be, and the exhibition provides an object lesson of what this particular London supply company is doing, and is prepared to do, in bringing about the wider application of electrical energy for power purposes. One of the most interesting features of the exhibition is the sub-station which the County of London Company has put up for supplying the necessary light and power to the exhibition, and a representative of PAGE'S WEEKLY was assured by Mr. T. W. Cole, who represents the promoting Company, that every possible contingency had been provided for, as regards current. Further attention will be paid to some of the exhibits in our next issue. The exhibition closes on the 5th prox.

Paddington Electricity Exhibition.

This exhibition has been organised by the Metropolitan Electric Supply Company, and its purpose, like that of the similar exhibition now open in Holborn, is to direct public attention, especially the attention of residents in the borough of Paddington, where that Company has the statutory supply of electricity in its hands, to modern developments of electricity for lighting, heating, ventilating, and power purposes. Electric lamps, shades, brackets, and other domestic fittings naturally take up a large proportion of the space on the forty stands, but many other applications of electricity also receive due attention. There is a good show of electrical heating and cooking appliances and of electrical radiators, whether for use in ordinary rooms or for medical purposes, while motors are to be seen attached to machines of all sorts, from chaff-cutters and horse clippers to organ-blowers and knife-cleaners. Mention may also be made of several varieties of electrical advertising signs, and of electrical pianos, which supplement the efforts of the Grenadier Guards band to provide music for visitors to the exhibition. Among more purely engineering exhibits there is a gravity bucket conveyer for coal, etc., with models of a water-tube boiler and mechanical stoker, and a magnetic separator for separating iron and steel from other materials.

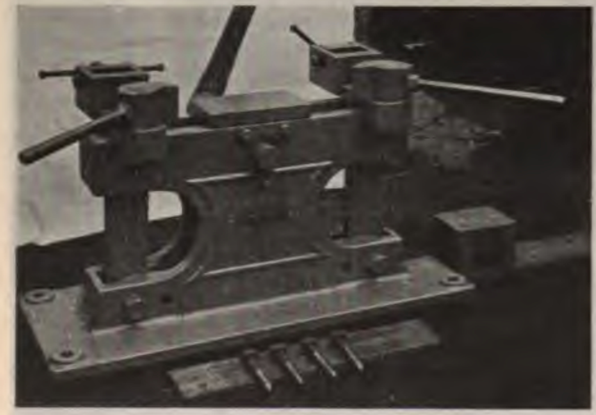
We understand that the projected second International Wireless Telegraph Conference will not take place during the present year.

An Accessory for the Smith's Shop.

The accompanying illustration gives a fair idea of a machine which is worked by hand in blacksmiths' shops for expeditiously welding iron and steel bars and shafts of various sections up to a diameter of 6 in. A description of the operation will, no doubt, interest those engaged in blacksmiths' work, and others who have to superintend same.

The machine is securely fixed to the ground near to the hearth on which the bars are heated. The two parts to be welded are first placed cold on the machine and the vices arranged so that the ends of the bar come exactly opposite each other, as seen in illustration. The bars are then heated to a short welding head and being quickly brought on to the machine, are gripped by turning the cams. The lever being immediately brought down, the ends of the bars are squeezed into each other. This slightly increases the diameter at the point which should be hammered down on the machine, the pressure being maintained during the process, and until all indication of the weld is obliterated. The welded bar is then removed to the anvil or steam hammer, and finished by the use of swages. It will be seen that this process saves the necessity for any "scarfing," or other preparation before the bar is heated, and a better job is secured than is possible by any other method.

The machine is also effective for welding up collars and bosses in iron bars, the pressure on the bar with one man at lever being equal to twenty tons. By reversing the machine it can be employed in drawing out or elongating the heated bar, and the great power which can be brought into operation enables the blacksmith to do a variety of work which otherwise would not be possible. The manufacturers are the Messrs. Joseph C. Nicholson Tool Co., of Newcastle-on-Tyne.



"STANDARD" WELDING AND FORGING MACHINE.

Dover-Calais Train Ferry.

The proposal to connect Dover and Calais by a train ferry is, as many of our readers will remember, by no means a new one. Sir John Fowler's scheme, which was before Parliament in 1870 and 1872, was rejected twice by the House of Lords, but we are not aware that any logical objections were urged against the scheme *per se*. Since then the utility of train ferries has been demonstrated in many parts of the world, and their advantages should appeal, not only to passengers whose business it is to cross the "Sleeve" in the quickest possible time, but also to manufacturers shipping goods. According to the Times, the scheme now before Parliament, which is backed on the Continent by Messrs. Schneider, of Creusot, the Compagnie de Fives-Lille, and Messrs. Hersent, is essentially the same as that of Sir John Fowler, except that the new harbour which he proposed to construct on the French coast at Andrecelles, on account of the deficiencies of the then existing harbours at Calais and Boulogne, has been rendered unnecessary through the improvements that have since been made at Calais. For the reception of boats at Dover the proposal is to construct a well-equipped marine station, where the transfer of the vehicles from the railway lines would be effected under the best conditions. For this part of the work Sir Douglas Fox is the engineer, and similar facilities would be provided at Calais. The difficulty presented at these ports by the large rise and fall of the tide is to be overcome by the use of big electric lifts.

On arrival the vehicles will be shunted on to the lift, and after it has been lowered to the appropriate level they will be hauled on board the boat over a short movable bridge by means of electrical windlasses, the whole operation taking a maximum of four minutes. For the sea passage four vessels are to be provided in the first instance, Sir William White being the naval architect. Of these, two, devoted to passenger service alone, are to be turbine steamers with a speed of 22 or 23 knots, and two cargo-boats of about 13 knots. The passenger boats are to be, in effect, moving stations; the two lines of rails on which the carriages will stand are to be completely covered in, so as to be protected from the weather, and there is to be a full allowance of saloons, refreshment rooms, etc., so that passengers who care to leave their seats will find ample accommodation. It may be mentioned that the International Sleeping Car Company has already prepared plans for a special train de luxe, weighing 380 tons, to be employed on the service. The whole scheme is to be controlled by a company having a capital of one million.

A PERTINACIOUS CURRENT.

LECTURE BY SIR OLIVER LODGE.

AT the Royal Institution on Friday evening last, Sir Oliver Lodge lectured on the subject of "A Pertinacious Current," a title which appears to have excited not a little curiosity. In his opening remarks Sir Oliver paid tribute to the important part played by that Institution in stimulating research. Referring to the new developments and discoveries in the domain of chemistry, as lectured on recently by Professor J. J. Thomson, he expressed the opinion that in physical and chemical science we were living in what he might term a fresh Newtonian epoch, and that it was well for us to realise this.

By the term "pertinacious current" he meant simply a high potential continuous current, a current going in one direction persistently in spite of obstacles which might be put in its path. He had been looking for such a current since 1884, and he had only recently been able to produce it. Such currents were of course obtainable by means of a battery of a quarter of a million cells, but that was a very inconvenient and expensive process, and he desired to obtain such a current by what he might term engineering methods, that was to say, in connection with a dynamo.

The method of obtaining high potential continuous currents was by the use of a one-way electric valve or rectifier. Thus, if the secondary of a Ruhmkorff coil were connected to a Leyden jar, then the provision of a rectifier which would allow the supply current to pass in, but prevent all exit, would enable the jars to be charged to bursting pressure, by a succession of intermittent pulses, so that a pertinacious current of discharge from the jar, through a leak or other high resistance, could be maintained. Sir Oliver showed an experiment in which he produced a London fog in a large glass globe, and by means of the discharge of such a current from a point connected to a jar, which was only momentarily connected with the source of supply, dissipated the fog, and he pointed out the obvious advantage of being able to do this by engineering methods rather than by having recourse to delicate high-tension electro-static machines. With reference to the manner in which these rectifiers work, the theory was put forward that their action is due to the rapid clearing away from the neighbourhood of the anode of all the carriers of positive electricity by means of the bombardment from the cathode, and to the fact that the current could only be conveyed by the agency of these positive carriers when they were allowed to come into actual contact with the positive terminal and travel to the back of the negative. It followed that the current that required their presence in that position was stopped if they were cleared away by bombardment, but the reverse current which required their presence at the other terminal could be easily transmitted if that terminal were screened. The bombardment was found in time to drive the gas out of the vessel, and in that way to create a very high vacuum, so that no current at all could pass, and it was therefore necessary to employ in the rectifier a vapour such as that of mercury, the supply of which could easily be maintained from a pool of the metal inside the vessel. The Cooper-Hewitt mercury lamp has been adapted for use in this way. Sir Oliver supported his theory by numerous diagrams and experiments.

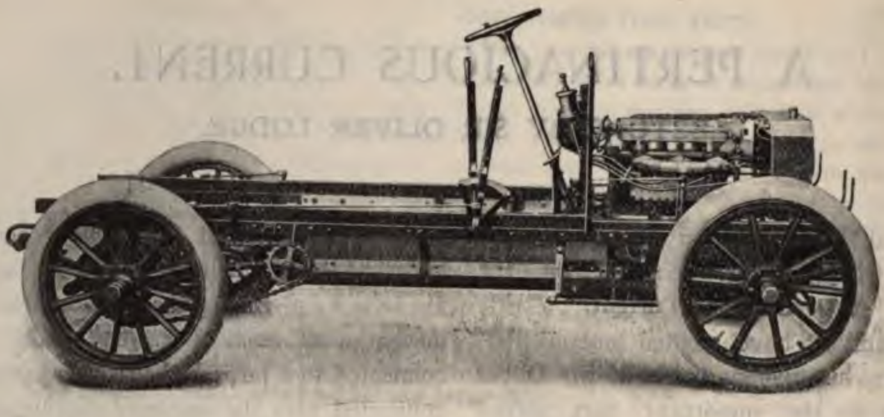


FIG. 1. MAUDSLAY 20-B.H.P. THREE-CYLINDER CHASSIS.

MOTOR NOTES.

MAUDSLAY MOTOR COMPANY, LTD.

THIS company has recently laid out a portion of its works for the manufacture of heavy vehicles, and it is also adapting its engines to marine work. There is little doubt that a great future awaits the internal combustion engine in its adaptation to the needs of the shipping industry, and the practice of supplying marine motors of the car type, or at least with all the chief characteristics of car design will be modified as the outcome of experience. Even at present the design of the Maudslay marine motor has been carefully revised in certain details, such as the starting gear, lubrication, and ignition.

The materials throughout are those best suited to withstand the corrosive action of salt water, and no aluminium is used where there is a possibility of its being affected by contact with sea water.

Accessibility to the various parts has received very careful attention. The valves can be very quickly removed owing to the special construction of the hinged layshaft. The countershaft bearings can be inspected and adjusted through the doors on the side of the base-chamber, and, if necessary, the pistons and piston-rods can be taken right out through these doors without disturbing any of the main joints of the motor.

All the moving parts are carefully balanced, and the weight of the reciprocating parts reduced to a minimum, the result being that Maudslay three, four and six-cylinder motors are claimed to create practically no vibration.

With the smaller sizes of Maudslay motors are fitted reversing and feathering propellers, and with the larger sizes a reversing gear, which is entirely enclosed in an oiltight case, and runs in a bath of oil so that there is said to be no possibility of its action being affected by the sea water.

The general design of the company's cars remains unaltered save in one or two details, making towards quicker and easier running. The 20 b.h.p. three cylinder engine is shown in fig 2. The valves open direct into the cylinders over the top of the pistons.

Two throttle valves are fitted in the inlet branch, one connected to the small hand-lever on the top of the steering heel, and the other connected to the clutch pedal so that when the clutch is withdrawn the engine is automatically throttled. As an alternative arrangement, a governor is mounted on the vertical shaft which drives the lay shaft, and a foot accelerator to cut the governors out when required.

STAR ENGINEERING COMPANY.

The exhibit of this firm attracted a good deal of attention at Islington. The company showed one 10-h.p. chassis, one 7-h.p. chassis, one 7-h.p. car brougham top, one 7-h.p. tonneau three-seated body, one 7-h.p. two-seated body, one 7-h.p. doctor's car, Victoria body, and one 15-h.p. car. A section of the 7-h.p. engine is shown in fig. 3. It is a balanced twin cylinder motor, the two cylinders being cast together. Automatic inlet valves are fitted with electric ignition. The bore is 3½ in., stroke 4½ in., and the normal speed 800 revolutions per minute. The company fits its well-known system of transmission gearing with three-point suspension, three speeds, and reverse, all actuated by one lever. All gear wheels are machine-cut from

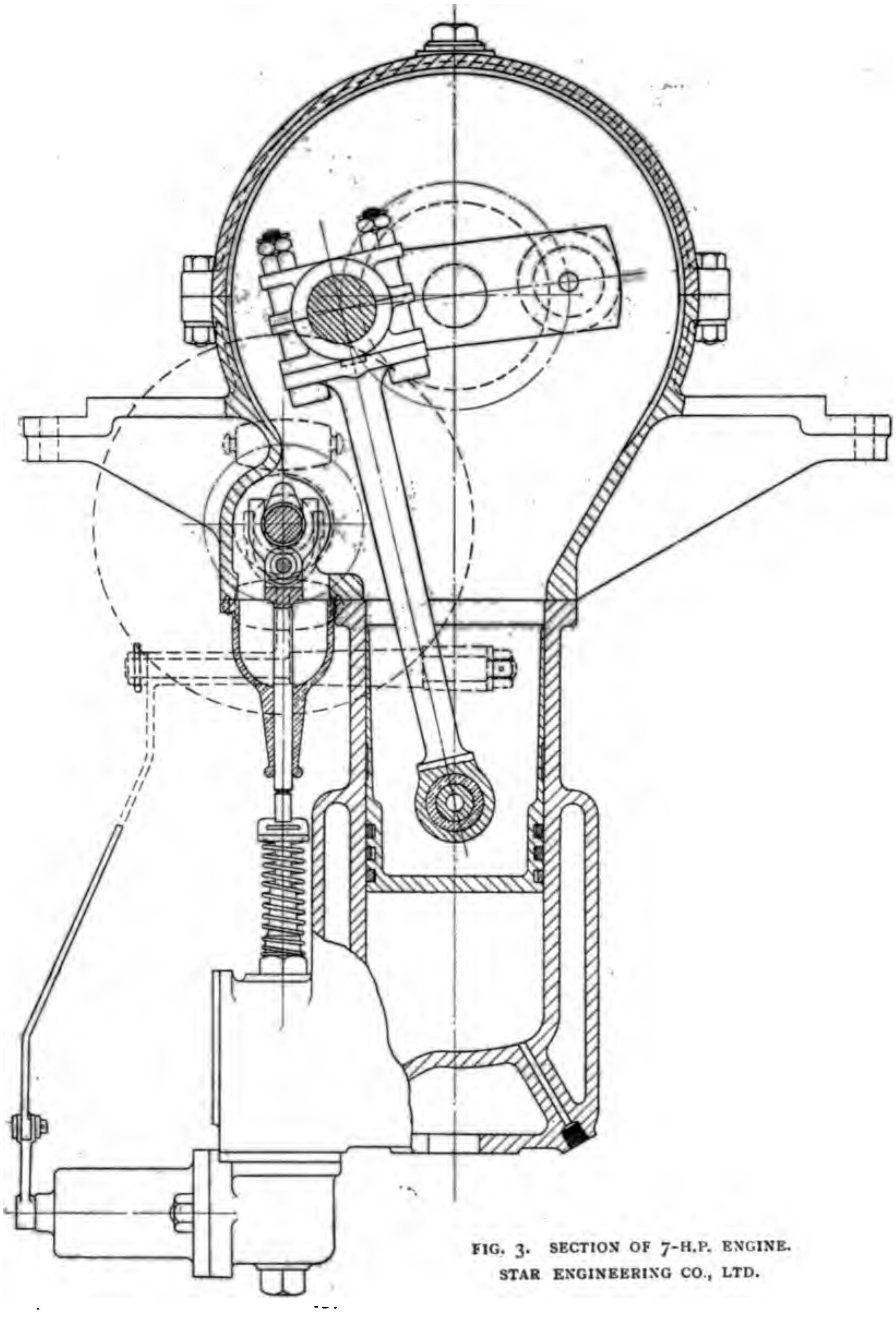


FIG. 3. SECTION OF 7-H.P. ENGINE.
STAR ENGINEERING CO., LTD.

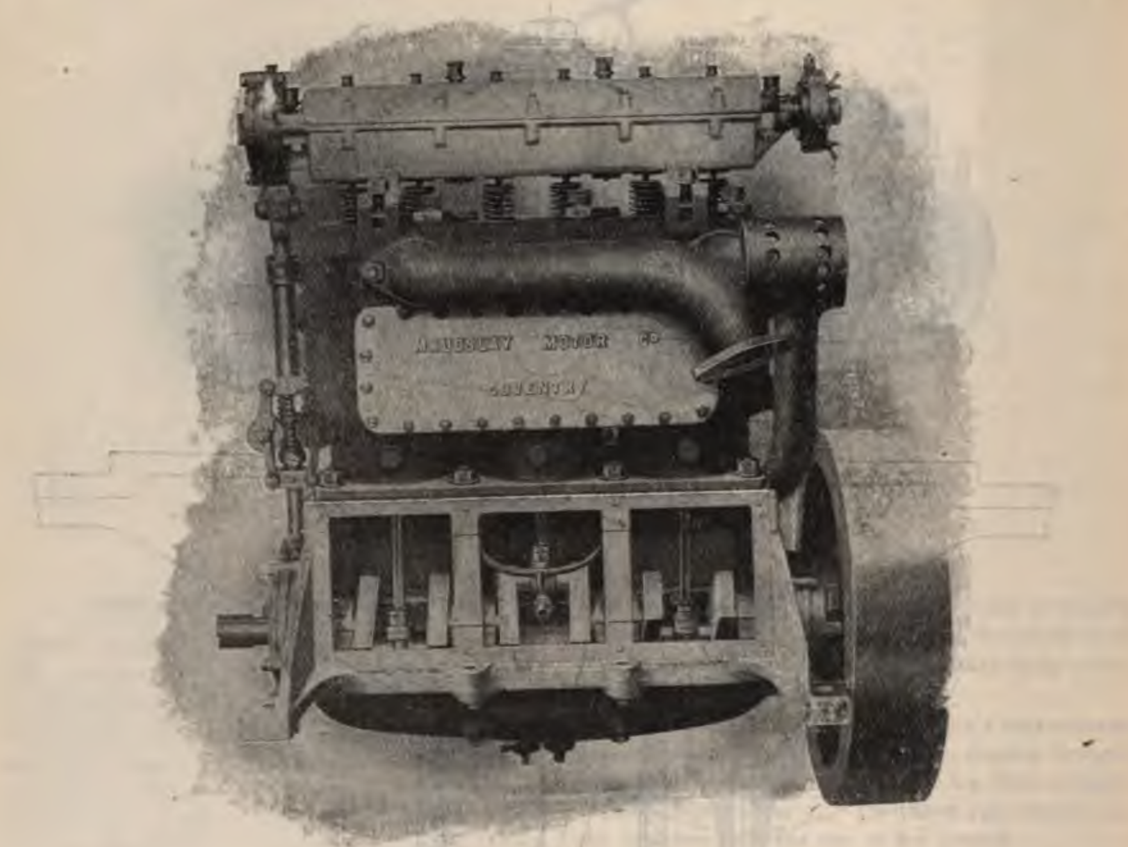


FIG. 2. 20-B.H.P. THREE-CYLINDER MAUDSLAY ENGINE.

selected steel, and case-hardened by the Star process. The frame axles are of special design, and the standard springs fitted are of carefully tempered spring steel. The brakes fitted on the chassis illustrated in fig. 1 are a metal to metal band brake on differential shaft actuated by foot pedal and a pair of powerful metal to metal internal expanding brakes on road wheels, operated by hand-lever. The steering gear is of the worm and sector type.

ELECTRICAL ENGINEERS' DINNER.

The first annual dinner in connection with the Manchester Students' Section of the Institution of Electrical Engineers was held in the Grand Hotel, Manchester, on Saturday evening, March 18th. Mr. C. D. Taite, the chairman of the Manchester Section, presided, and there were about eighty members and friends present. Mr. F. O. Mills proposed the toast of "The Institution of Electrical Engineers." and said that although the Manchester Students' Section had only been in existence for about one and a half years, it had grown to a membership equal to that of the similar section in London. Mr. C. D. Taite, in responding, heartily congratulated them upon the progress they had made. Last April, he said, the number of members was one hundred; they had now three hundred. A Local Students' Section possessed advantages from many points of view, and gave the members opportunities of discussing technical points in public which was of great usefulness to them when they became members of the Senior Section. Mr. A. E. Jepson proposed "Our Guests." Mr. E. W. Cowen, in responding, congratulated the members on the successful progress made. He thought the electrical industry had been under a cloud for some time, but hoped that it was now passing, and that before long a great improvement would take place. He pointed out the splendid opportunities which the members had in the Manchester School of Technology, and also in the British Westinghouse Company's works. Mr. R. W. Willis proposed "The Scientific and Technical Societies of Manchester," to which Mr. O. Lemon replied. A good musical programme was provided.

THE 1905 PATENT RULES.

IMPORTANT MEMORIAL.

THE following letter and memorial have been forwarded to the President of the Board of Trade by Sir Lloyd Wise. The memorial is a most weighty representation, whether measured by the eminence of the scientists who have signed it, the millions of capital represented by the manufacturers who have done so, or by the thousands of workmen they employ. As will be gathered from the opening part of the letter to Lord Salisbury, the signatories constitute in other respects a truly representative body. The memorial bears between 500 and 600 signatures.

46, Lincoln's Inn Fields, London, W.C.,
25th March, 1905.

To the Most Noble the Marquis of Salisbury, C.B., P.C.,
President of the Board of Trade.
Patents Rules, 1905.

MY LORD,—Herewith I have the honour to submit for your lordship's favourable consideration a memorial with respect to the above-mentioned rules.

The signatories include many eminent persons and firms, amongst the former being a number of prominent Fellows of the Royal Society, several past presidents of the Institution of Civil Engineers, the president and several past presidents of the Institution of Mechanical Engineers, the president-elect and several past presidents of the Iron and Steel Institute, several vice-presidents and members of council of the Institution of Naval Architects; also presidents, past presidents, and members of council, Fellows, and members of various other influential bodies, engineers, metallurgists, and chemists, many well-known professors, solicitors, and experienced patent agents, numerous inventors, patentees, and others interested in furthering the progress of industry by the introduction of improved processes and products.

In transmitting this memorial may I be permitted to submit to your lordship that—

1. For over thirty years the adoption has been advocated of a measure on the lines of Section I. of the Patents Act, 1902.

2. The object in view was to afford, both to the inventor and to the public, the benefit of an official examination as to novelty, without, however, incurring the serious risk of inflicting injury upon an inventor by refusing a patent for alleged want of novelty or by making public adverse official opinions.

3. Prior to the Act of 1883 a memorial was presented to Mr. Chamberlain in favour of such a scheme, but presumably, owing to the great expense involved, he did not provide in that Act for official examination as to novelty. Nevertheless, that portion of the scheme which provided against publication of official opinions in unopposed cases was embodied in the Act (subsection 5 of section 9 of 1883 Act, as amended by 1888 Act).

4. The original idea was simply to ensure that where the applicant for a patent and the authorities differed as to patentability, the authorities should have the right to compel the applicant to mention in his own specification any prior specification or specifications a knowledge of which might seem to be necessary to enable the public to form an accurate opinion as to the patentability of the applicant's alleged invention.

Thus the public would be amply protected, less moral responsibility would be thrown upon the authorities, and the inventor would be given absolutely fair play.

5. The new rules, on the other hand, are obviously based upon the idea that the authorities are charged with the responsibility of publishing to the world an official opinion whenever it appears to them that no patentable invention is disclosed, and although the Act only provides for insertion of a reference *in* an applicant's specification (which must, according to the principal Act, end with the claim), Rule 10 actually goes so far as to prescribe an endorsement outside the legal limits.

Surely the Act would not have expressly provided against publication of reports of examiners if the intention had been to cast upon the authorities the responsibility of advising the public as to patentability, as distinguished from merely requiring the applicant to refer to any prior specifications, to which, in the opinion of the authorities, the public ought to have their attention drawn, in order not to be misled by an applicant's specification, deemed, in the absence of such reference, to be wanting in clearness or otherwise misleading.

6. It is pretty generally recognised that, with thousands of cases to deal with every year, there will be cases

in which the Comptroller and his staff, and even the law officers on appeal, will form erroneous conclusions, to the irreparable injury of inventors; whereas nobody could be irreparably injured by failure to endorse upon an applicant's specification an adverse official opinion.

7. I gather that official references to prior specifications will only be insisted on when the applicant or his agent does not amend his claims so as to avoid the references cited, or does not acknowledge or disclaim the prior state of the art.

Let us test the value of this. To that end let us assume the extreme case of an applicant filing as his specification a verbatim copy of a previously published specification less than fifty years old, but with a specific disclaiming reference to that specification, thus: "I am aware of the specification of Letters Patent No.—— dated—— granted to—— and I make no claim to anything described or claimed therein.

What would the Comptroller do in that case?

I am not without reason for believing that he would place an official endorsement upon the specification, notwithstanding that it already contained a specific reference to the prior specification by way of notice to the public, so that any one interested in the matter would naturally be led to compare the two specifications and at once realise the position.

Why, then, would the official notification be placed upon the specification?

The obvious inference is that it would be done, not merely to notify in accordance with the Act the existence of the prior specification, but for the express purpose of communicating to the public the opinions of the Comptroller and Examiner that the invention had been wholly anticipated, and that the patent was therefore bad.

It may be urged that in such a case no injustice would result.

On the other hand, it would be equally true to say that in such an obvious case no advantage to the public would result from the official endorsement.

But that is not a sort of case likely to arise in actual practice.

Once concede that, notwithstanding specific reference to a prior specification by the applicant in his own specification, an official notification may nevertheless be endorsed upon that document, the door to injustice and oppression is at once opened.

The real danger will arise where the officials regard as identical things that are not really identical.

It is inconceivable that such cases should not occur, remembering the more or less perfunctory way in which applications numbering thousands upon thousands every year will necessarily have to be dealt with on mere paper comparison.

As an experienced professional witness told the departmental committee, 'An examiner is like a patent agent; he is not infallible."

And the late Mr. John Imray, an exceptionally experienced practitioner, when giving his evidence, said, "A man looking at a publication, say, thirty or forty years old, when he has an invention before him reads that in a very different spirit from that in which he would read it if he had not known of the invention then before him. Therefore he interprets that very often as an anticipation which is no real anticipation. We know this, that in the High Court of Justice it requires the most profound judicial heads often to distinguish what is anticipation and what is not, and that task cannot be entrusted to any number of examiners."

And, again, "My experience in the Patent Office is, in Germany and the United States and Sweden, that they are not capable of looking at it in the right way; but that they call things anticipations which are not really anticipations."

The rules are so framed that an endorsement upon a specification according to Rule 10 will be at least equivalent to an official notification that in the opinion of the Comptroller the specification is open to objection on the ground that the invention claimed thereby has been wholly or in part claimed or described in the previous specification.

That is going far beyond merely requiring reference to the prior specification to be made in the applicant's specification, where it would operate to cure the defect.

But Rule 10 goes much further, by providing that where the reference is inserted as the result of a provisional report under Rule 7 a statement to that effect shall be added to the reference.

This is exactly the same thing as if the Comptroller should place upon the applicant's specification a statement in these words, viz.: "The examiner has reported to the Comptroller that in prosecution of the investigation prescribed by subsection 1 he has found that the invention claimed in this specification has been wholly claimed or described in the prior specification above cited."

With great deference I fail to see how it is possible to justify such a course in the teeth of subsection 4 of section 1 of the 1902 Act, which makes applicable to such reports the provisions of subsection 5 of section 9 of the principal Act, as amended by any subsequent enactment, thus expressly prohibiting the publication or opening to public inspection of the reports of examiners.

Referring to official endorsements, the Right Hon. Joseph Chamberlain, when introducing the Bill of 1883, said: "This would practically come to the same thing as the rejection of the patent, as no manufacturer would deal with a patent so endorsed."

Again, in a recent article in The Times Financial and Commercial Supplement it is pointed out, with respect to the proposed official endorsements, that: "A reference of this kind will, of course, seriously reduce in the public estimation the value of a patent, and great care will, therefore, have to be taken that no injustice is done to the inventor. The public does not realise as do those familiar with patents and patent litigation how very difficult it is in many cases to decide that an invention is covered wholly or partially by a specification of earlier date, and even though a specific reference be not intended to have the effect of such a decision, it will be so interpreted by the public."

"Specific reference" in that article means, of course, an official endorsement according to Rule 10.

8. No part of the Act appears to justify the making publicly known the nature of either an examiner's report or the Comptroller's opinion, as provided for by Rule 10, and so long as the rule remains in its present form neither the Comptroller nor any other official charged with giving effect to it can avoid the adoption, at least occasionally, of a course which, as is submitted, will contravene the Act. In other words, the Act does not authorise the Comptroller to endorse (as Rule 10 practically requires him to do) his opinion or the examiner's opinion upon an applicant's specification.

9. That the Comptroller and all other responsible officials will use every effort to give effect to the rules judiciously and so as to cause the "minimum" amount of friction is not doubted. But very many experienced persons share the opinion expressed in The Times article already referred to that "the danger will be more apparent in the days to come, when a staff is in power which has only known the new system, and it is almost certain that then friction will frequently occur between the authorities and the applicants for patents."

10. In conclusion then, I respectfully submit (*a*) that the public interest will be amply protected in even the closest case by mere mention of the prior specification or specifications by number, date, and name by the applicant himself in his own specification, that the form of reference provided by Rule 10 is antagonistic to the spirit of the Act, because such references will have the effect of communicating to the world the pith of the Comptroller's adverse opinion, and, where Rule 7 is referred to, will be equivalent to publication of the examiner's report in defiance of the express provision of subsection 4 of section 1 of the Act of 1902; (*b*) that the Act does not authorise the Comptroller to officially endorse an applicant's specification; (*c*) that, even assuming the endorsements to be legalised, they would only be justifiable in case an applicant failed to specifically mention in his own specification the prior specification which he had been informed the Comptroller (after having heard the applicant) considered it necessary to mention; (*d*) that such endorsement should be in a form which would not impart to the public the nature of the Comptroller's opinion, much less the pith of the examiner's report.

I have the honour to be, my Lord, your Lordship's
most obedient servant,
W. LLOYD WISE.

MEMORIAL.

January, 1905.

To the Right Honourable the President of the Board of Trade.

SIR,—

The Patents Act, 1902, and the Patents Rules, 1905.

To the Departmental Committee on whose report the Act was based there was sent, in 1900, an influentially-signed communication, to the following extract from which we earnestly invite your attention:—

"As, however, patents have sometimes been ultimately supported in respect of inventions which even eminent judges have regarded as not patentable, it is not advisable, in any unopposed case, that letters patent should be refused on the ground that the invention, or alleged invention. . . . has been previously patented in this country, provided the applicant (if required) so amends his specification as to indicate what was previously known, thus protecting the public against being misled. Furthermore, it is not advisable either to make it publicly known that the specification has been amended at the instance of the Patent Office authorities, or to give publicity to any official notification of any kind (whether by endorsement on the specification or otherwise) implying doubt as to the novelty of the subject-matter in respect of which letters patent are granted, because such publicity would obviously create prejudice against the patent; and, where based upon erroneous opinion, would operate unjustly."

As Rules 9 and 10 now stand, however, when the Comptroller determines that reference ought to be made in the applicant's specification to a prior specification or specifications by way of notice to the public, the form of reference must be as follows and be inserted after the claims:—

"Reference has been directed, in pursuance of section 1 subsection 6, of the Patents Act, 1902, to the following specification of Letters Patent No...... granted to................"

Where the reference is inserted as the result of a provisional report under Rule 7, a statement to that effect must be added to the reference.

Such a reference will virtually make public the pith of the examiner's report, notwithstanding the enactment that reports of examiners shall not in any case be published or be open to public inspection (subsection 4 of section 1 of 1902 Act, and subsection 5 of section 9 of 1883 Act, as amended by 1888 Act).

Moreover, although based upon mere opinion, which may be erroneous, it will usually render a patent commercially worthless.

This is a very serious matter, seeing that, in the past, large manufacturing concerns, which have rendered public service by introducing articles of great utility not previously on the market, besides giving employment to many thousands of workmen and others, have accomplished these beneficial results under patents for inventions as to the novelty of which (in the patentable sense) expert and even judicial opinions have differed.

We, therefore, hope that it will be found possible to forthwith so modify the rules as to obviate the unnecessary risk they at present involve of seriously retarding the introduction of improvements which, though individually of a minor character, do, in the aggregate (to quote the Select Committee of 1872), contribute greatly to the progress of industry.

To this end we venture to suggest revision in the sense that in no case shall either an official notification be endorsed upon, or a stereotyped form of reference be inserted in an applicant's specification, unless and until he shall have been notified of the Comptroller's determination, and shall have been afforded, and shall have failed to exercise, the option of himself inserting in his own specification a reference, by number, year, and name (and not in a stereotyped form) to the prior specification (or specifications), reference to which the Comptroller shall have determined ought to be made in the applicant's specification by way of notice to the public.

We submit that the Act does not provide for official insertion in, or endorsement upon, an applicant's specification of any notification; and, moreover, that, as the specification is addressed to the public, a reference in it to a prior specification or specifications, inserted by the applicant himself, would obviously constitute a notice thereof to, and would adequately protect the public, without necessarily injuring the applicant, as any official notification inevitably will.

Should it, however, be insisted that the modified procedure we recommend cannot be adopted as the law now stands, then, regard being had to the importance of the interests involved, we trust his Majesty's Government will see fit to introduce a short Bill in the coming Session of Parliament, with a view of clearly legalising the proposed change in the rules.

We have the honour to be, Sir, your most obedient servants.

(SIGNATURES FOLLOW.)

Among those who signed the petition were the following: Lord Kelvin, Professor J. O. Arnold, Mr. John A. F. Aspinall, Mr. Edwin Adams.

Sir William H. Bailey, Sir Benjamin Baker, Mr. A. F. Berry, Sir Nathaniel Barnaby, Professor Biles, John Brown and Co., Ltd., Bell's Asbestos Co., Ltd., Browett, Lindley and Co., Ltd., Mr. D. Bain, Professor Barr, The British Luxfer Prism Syndicate, Ltd., Sir Henry Bessemer and Co., Ltd., Mr. W. Worby Beaumont.

Sir E. Hamer Carbutt, Bart., The Central Marine Engine Works (W. Gray and Co., Ltd.), Professor D. S. Capper, Mr. Henry Chapman, Mr. Samuel Chatwood, The Castner Kellner Alkali Co., Ltd., Clayton and Shuttleworth, Ltd., Mr. W. H. Caldwell, Major-Gen. Sir J. F. Crease.

Sir Raylton Dixon and Co., Ltd., Dick, Kerr and Co., Ltd., Dr. Bernard Dyer, Symmers Day. and Co., The Ebbw Vale Steel, Iron and Coal Co., Ltd., The Edwards Air Pump Syndicate, Ltd., Dr. Francis Elgar, Sir J. Fortescue Flannery, Bart., M.P., Mr. Edward Field, Frame Food Company, Ltd., Mr. L. F. Gjers, Sir Howard Grubb, Geipel and Lange.

Mr. R. A. Hadfield, Holden and Brooke, Ltd., Mr. H. Graham Harris, H. and W. Hawthorn, Leslie and Co., Ltd., Hick, Hargreaves and Co., Ltd., J. H. Holmes and Co., Mr. James Holden, Mr. Andrew Johnston, Professor A. B. W. Kennedy, The Leeds Forge Company, Ltd., The Leeds Phosphate Works, Ltd., Mr. Frederick Mills, Sir William Mather, Mather and Platt, Ltd., Mavor and Coulson, Ltd., Mr. D. B. Morison, Marshall, Sons and Co., Ltd., Merryweather and Sons, Mr. Charles H. Merz, Dr. Ludwig Mond.

Musgrave and Sons, Ltd., Mr. W. M. Mordey, Mr. W. H. Maw, Mr. Edward P. Martin, The Pulsometer Engineering Company, Ltd.

Sir Edward J. Reed, Professor W. Ripper, Mr. Mark Robinson, Sir Thomas Richardson, Mr. John S. Raworth, Professor Henry Robinson, Mr. E. Windsor Richards, Sir Henry Roscoe, Mr. Robert Ropner, Sir William Ramsay.

Mr. James Swinburne, Spencer, Moulton and Co., Ltd., Mr. Charles Scott, Sir J. Wilson Swan, Mr. J. E. Stead, J. Stone and Co., Ltd, Spillers and Baker, Ltd.

Mr. John Tweedy, Professor Silvanus P. Thompson, Sir John Thornycroft, John I. Thornycroft and Co., Ltd., Colonel Sir C. E. Howard Vincent, Mr. H. S. Wainwright, Mr. J. H. Wicksteed, Mr. J. M. While, Mr. W. P. Wrightson, The Wallsend Slipway and Engineering Company, Ltd., Mr. A. F. Yarrow.

NAVAL NOTES.

GREAT BRITAIN.

TWO more destroyers, the *Swale* on March 20th and the *Garry* on the following day, have been launched, making a total so far this year of eight. The *Swale* is of the same type as the other destroyers of the 1903–4 programme, but an entirely new form of hull has been adopted in the case of the *Garry*, and her trials are expected to be unusually interesting.

The *Forward* scout begins her trials this week, and the *Pathfinder* has already half completed hers. The *New Zealand* having developed slight machinery defects had to abandon her four-fifths power trial after running for fifteen hours at an average speed of 18 knots, but the *Devonshire* cruiser has successfully completed the second trial and attained a speed of 21 knots.

FRANCE.

The decision of the Minister of Marine on the question of the design of the *Waldeck Rousseau* has been announced, and it seems that this vessel is to be of the dimensions of the *Edgard Quinet* (with a higher speed), but the armament will be similar to that of the *Jules Ferry*. That is to say, her displacement will be 13,700 tons, length 515 ft., beam 70 ft., draught 26¼ ft.; her engines are to be of 36,000 h.p., and to give her a speed of 23 knots. For armament she will carry four 7·6 in. sixteen 6·48 in., twenty-four 1·85 in., and two 1·45 in. guns. The estimated cost is £1,163,080, and she is to be completed in four years from the date of commencement, which will be sometime at the end of this summer, as the *Jules Michelet* will occupy the only available slip until then.

ITALY.

The trials of the *Regina Margherita* have been completed with fairly satisfactory results. On her first trial at 14,000 h.p. she attained a speed of 19·3 knots, and later with 20,600 h.p. the speed was 20·2 knots. It will be noted that for an increase in power of nearly 50 per cent. the increase in speed was slightly less than one knot, and this is a matter the Italian authorities might well give attention to. With some of our *County* cruisers, a rather similar experience occurred, and it was not until the propellers had received attention that the vessels were able to give such excellent performances as they are now capable of. The *Regina Margherita's* boilers are of the Niclausse type.

JAPAN.

The estimates for 1905–06 come to a total of 780,000,00 yen (£19,500,000), including ordinary and extraordinary expenditure.

Three new destroyers, built in Japan, have been commissioned, the *Ariake*, *Fubuki*, and *Arare*, all of 29 knots speed.

The new Japanese battleship *Kashima* was launched at Elswick on Wednesday. She has a displacement of 16,400 tons, and is 455 ft. long, with 78 ft. beam, and 26 ft. 8 in. draught. Fully equipped, her displacement will exceed 17,000 tons. She carries the very powerful armament of four 12-in. guns in her two main barbettes, four 10-in. guns singly in barbettes, twelve 6-in. guns in the citadel, twelve 12 pr., three 3 pr., six Maxims, and five torpedo tubes. The armament has been so placed that the pieces shall not interfere with each other in firing, and every gun has a considerable arc of training. The armour amidships is carried from the water line to the upper deck with 4-in. screens, rising 7 ft. 6 in. higher, and covering the 6-in. gun positions amidships as well as the spaces between the 10-in. gun positions. The main armour belt extends the whole length and is 9 in. thick amidships tapering slightly at the extremities. It extends 5 ft. below water and 12 ft. 6 in. above, while the side plating on the higher level is 6 in. thick amidships, with 6 in. of steel for the citadel. Here are ten 6-in. guns separated by screens and firing through ports similar to those in casemates. The other two 6-in. guns are on the upper deck amidships, behind the 4-in. screen, which has been alluded to. The 12-in. barbette armour varies from 9 in. to 5 in., while the 10-in. barbettes have 6-in. armour. The steel protective deck is 2 in. thick on the flat, and 3 in. on the slopes which go down to the bottom of the main armour deck. There is also a thick protective plating worked on the top of the screen armour at the level of the boat deck. The ship is provided with twenty Niclausse boilers, and the speed is to be 18½ knots. She will have two large steel masts, each having searchlights and gun-controlling platforms. Helm indicators are provided, and there will be an elaborate installation of telegraphs, voice pipes and telephones. The complement of the ship will be about 980 officers and men.

The sister ship *Katori* is expected to be launched in the course of a few days.

HIGH-SPEED RAILWAYS.

THE KEARNEY-THOM SYSTEM.

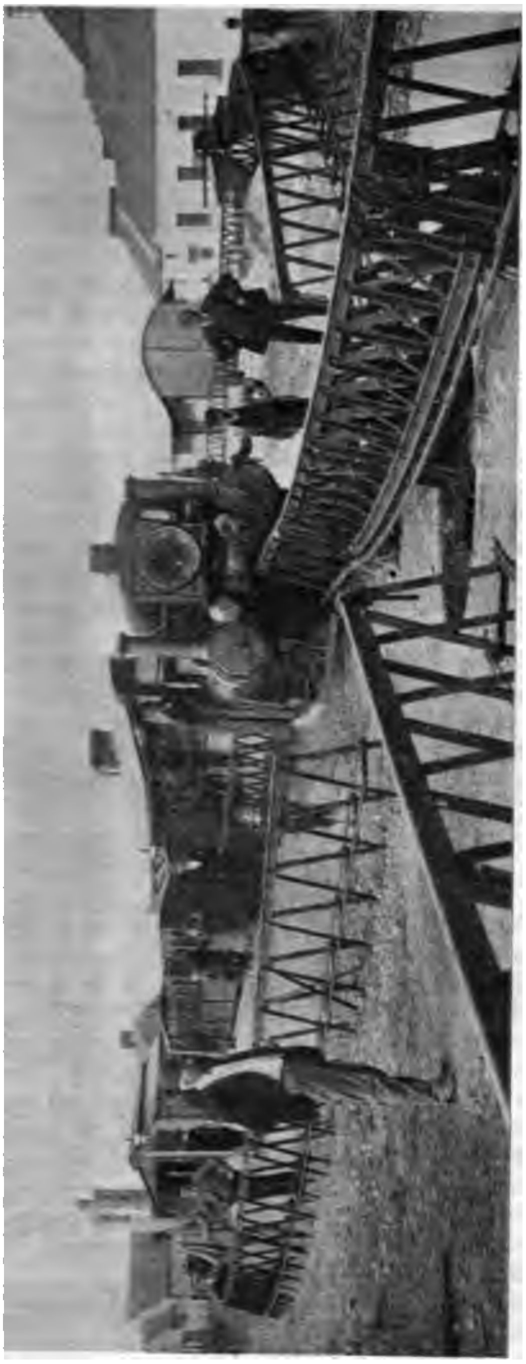


FIG. 1. MONO RAIL STEAM LINE (BEHR SYSTEM) BETWEEN LISTOWEL AND BALLYBUNION, IRELAND.

INVENTORS are constantly applying their energies to a solution of the problem of devising a cheap and effective high-speed rail track. The mono-rail principle is a favourite one with experimenters in this field. The first idea of a single line rail dates back for a century, but of modern systems one of the best known in the Behr, illustrated in fig. 1. To the inventor belongs the credit of designing the first mechanically-driven train on a single rail track, and the line from Listowel to Ballybunion has amply demonstrated the safety of the system.

Another system of proposed electric traction to which attention has lately been directed is that known as the Kearney-Thom, for which the Rev. R. Riach-Thom is mainly responsible, and which Mr. E. W. Chalmers Kearney is developing and exploiting. In this system the whole weight of the carriage (fig. 2) is borne by the ground rail. To keep the carriage in an upright position a grooved upper rail is employed. The superstructure for the support of the upper rail is made of channel steel, which it is claimed gives the necessary rigidity. Lessened friction, the simplicity of points and crossings, the possibility of using very light cars, and adaptability to overhead and tube railways are some of the special features of this invention. It is stated that in the case of tube railways a considerable economy in construction is effected by the use of tunnels of smaller diameter, owing to the fact that the bottom rail can be bolted to the tube itself.

In fig. 3 is shown a side elevation, displaying all rollers in position, with method of gearing from armature shaft to driving axles by means of three spur wheels. Here A is the armature shaft ; B the motor ; C gearing with three wheels ; D circular segments with iron plates secured to them to bear the side rollers ; E a driving wheel ; F frame of bogie ; G rollers at end for up and down movement ; H side rollers for taking curves ; J side vertical rollers for use when bogie is on a curve ; K body of car ; L circular ring or path for rollers attached to body of car ; M a safety catch plate, put on at each side of bogie under the side rollers, and fastened by screws at each end.

Fig. 4 shows cross-section of car, and the following will explain the construction : *A* seats ; *a*1 windows ; *a*2 floor framing ; *a*3 one of the ribs ; *B* standards ;

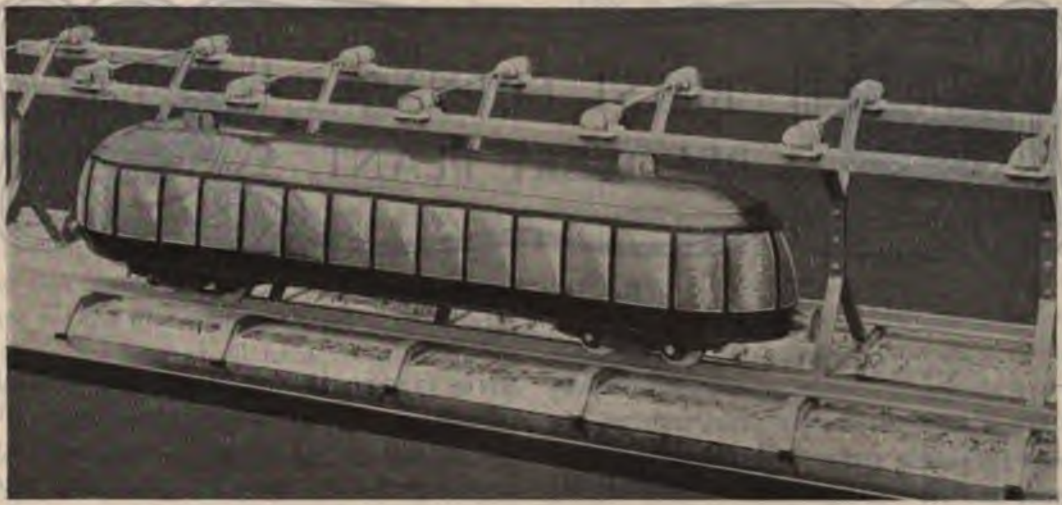


FIG. 2. KEARNEY-THOM SYSTEM. THE LATEST APPLICATION OF THE SINGLE RAIL TRACK.

b insulators; *b*1 the rods; *b*2 bottom sleeper; *b*3 dogs to hold rail and sleeper; *b*4 chocks or stoppers for insulators.

FEATURES OF THE KEARNEY-THOM SYSTEM.

As already stated, superiority over other methods is claimed for the Kearney-Thom in the simplicity of points and junctions, and in the adaptability of the system to very light cars. At the same time the maximum of tractive force is said to be obtained by the whole weight of the car being directly on the driving wheels, so that high acceleration can be obtained with economy. Provision would be made for wheel breakages so that in the event of such a contingency arising the cars would still be held in their normal position by means of checks. In the Kearney-Thom system only six wheels are used for each car; four bearing wheels (2ft. 6in. in diameter), which are doubly flanged, and are arranged in sets of two at each end of a car. Four motors of 50-h.p. each would be used for ordinary speeds, but on a high speed line eight motors would be used, two on each wheel, one either side; the individual h.p. would also be considerably increased. It is claimed that a speed of 150 miles per hour could be attained.

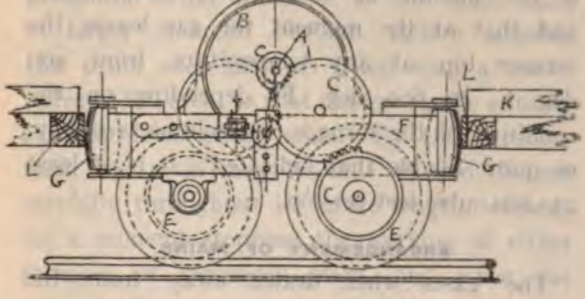


FIG. 3. SIDE ELEVATION, SHOWING ALL ROLLERS IN POSITION. KEARNEY-THOM SYSTEM.

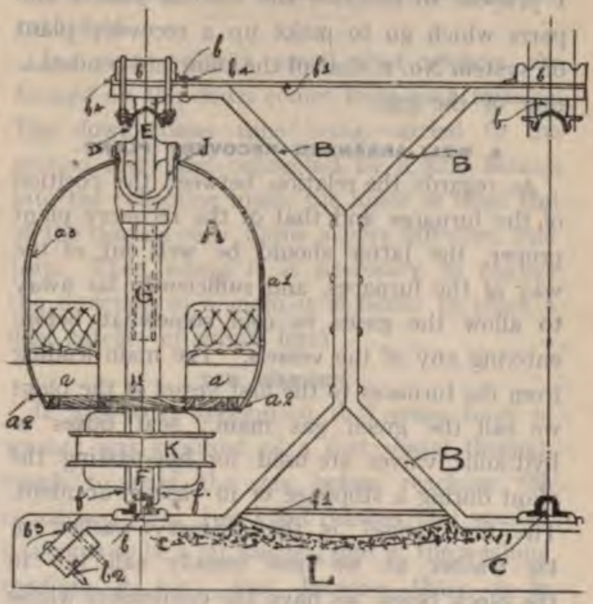


FIG. 4. CROSS SECTION OF CAR. KEARNEY-THOM SYSTEM.

BLAST FURNACE RECOVERY PLANT.

By J. Gillespie.

THE heating properties of the furnace gases had been in use for some time as the agents for raising steam for blowing and other engines and for heating blast for the furnaces, but it was not till 1879 that any successful attempt was made to recover tar and ammonia from blast furnace gases.

The various systems and patents divide themselves into two classes—I borrow here the classification given by Lunge—(1) "Methods depending on the condensation or cooling of the gas"; (2) "Methods depending upon the use of acids, without the cooling of the gas." I propose to describe the various vessels and parts which go to make up a recovery plant on system No. 1, that of the complete condensation of the gas.

A WELL-ARRANGED RECOVERY PLANT.

As regards the relation between the position of the furnaces and that of the recovery plant proper, the latter should be well out of the way of the furnaces, and sufficiently far away to allow the gases to cool somewhat before entering any of the vessels. The main leading from the furnaces to the first vessel of the plant we call the green gas main; seal boxes or hydraulic valves are used for bye-passing the plant during a stoppage or in case of accident. The first vessel is the primary washer, or tar washer as we now usually call it: in the block below we have the condensers whose name explains itself. The order of the next three portions of the plant varies in different works, in some cases we have one liquor washer placed before the exhausters and one after, but in other works, and these include the most recent, we find the exhausters placed immediately after the condensers, and both washers after the exhausters. The main going back to the stoves and boilers from the final washer we know as the return gas main.

In the briefest outline this enumerates the essential portions of the plant, the green gas main or mains, the tar washer, the condenser, the exhausters, the first and second liquor washers and the return gas mains. The great volume of gas to be dealt with from even a single furnace, causes the dimensions of a recovery plant to be considerable, and nothing has ever been gained, but much has been lost, through keeping down the sizes of mains and vessels. Though it is customary to reckon the volume of gas to be dealt with as 140 to 150,000 cubic feet per ton of coal put into the furnace, it must be borne in mind that this is the volume at atmospheric temperature, and that at the moment the gas leaves the furnace top, at any temperature from 400 deg. F. to 600 deg. F. depending on the condition of the furnace, its volume is nearly, or quite, double that indicated; it is at least 250,000 cubic feet per ton.

ARRANGEMENT OF MAINS.

The gases when drawn away from the furnace top are conveyed down vertical pipes into the main common to all the furnaces.

The quantity of gas produced by one blast furnace of ordinary dimensions varies from 12 to 15,000,000 of cubic feet per day, and to allow of a reasonable rate of travel, the main requires to be made of large size, for four furnaces about 7 ft. or 8 ft. diameter and for six furnaces not less than 9 ft. The rate of travel is about 800 ft. per minute, this looks very high but is approximately right as any who has watched the gas passing through a plant for the first time will readily appreciate; it seems no time at all from the moment the first dirty gas enters the plant till it is up to the exhausters and ready for their action. The gases entering the green gas main are at a high temperature and it is necessary to line the main with firebricks to prevent too rapid condensation of the gas and consequent deposit of tar in the main. If this main be fixed in its position at both ends, it is necesary to provide means of expansion in its length on account of its variations in temperature.

There is not much possibility for improvement in such a simple construction as a collecting main, but one such improvement has been carried out in the work last erected in Scotland. The green gas main has been duplicated throughout the full length of the furnaces, that is to say, there are two full-sized mains with separate connections to each furnace.

Each of these connections can be closed off from the furnace by a valve near the top. At the end of the double main nearest the recovery plant the two mains pass into a large horizontal drum and issue as one single main of larger diameter beyond. Before entering this drum each main is fitted with a crown valve of full area, so that the gas can be entirely shut off from either main. By this arrangement one main may be shut off and cleaned carefully throughout its entire length, without for a moment stopping the working of either furnaces or recoverey plant, and when the one in action requires attention the clean main can be as readily put into use again.

DUST REMOVAL.

One of the greatest difficulties in the way of dealing with blast furnace gas, and a difficulty which seems every year to grow more serious, is the question of the removal of the mechanical dust from the gas; the very fine particles of ore and coal driven over by the blowing engines and pulled forward by the suction of the exhausters. The finely divided condition of many of the ores now in use has much increased this difficulty, and it has only been partially overcome by the conversion of these finely divided ores into briquettes.

There is as yet no royal road to the removal of this dust, and the only resource that is effective is the provision of ample means of access to the mains and the regular and persistent cleaning of the green gas main and all its seal vessels and dust catchers. If this cleaning is not thoroughly attended to, and if the dust is allowed to accumulate in the bottom of the main, the area of the main is contracted, the current of gas travels more rapidly, and the dust is carried further and further forward till it comes into vessels where it does damage, and it has to be dealt with and got rid of.

In recent plants small dust-catchers are formed on the down comer from each furnace. The down comer tube being carried to the ground level and connected by a side branch into the collecting main, the lower or dead end of the down comer forms a very effective dust trap. Then where it is necessary to change the direction of a main it is better to place a dust catcher of simple form.

TAR WASHER.

It was early recognised that some form of washer was required as a first vessel through which to pass the gas before reaching the condenser. For two good reasons this washer has come to be a tar washer, that is, the washing medium is tar; first, because there is in the gas a light or sooty tar not easily washed out by water, but readily taken up by tar;

and, secondly, it is a most economical way of getting rid of the moisture in the tar formed in other portions of the plant, by passing it through this washer and exposing it to the great heat of the gas.

In fig. 1 is shown an interesting vessel from the original Coltness plant. This tar heater was, like the dust chamber, a large cylindrical vessel, 30 ft. diameter by 60 ft. high. The gas entered at the circumference near the bottom, and passed upwards through spiral passages formed by trays in the vessel. An internal tube allowed access to the top, and inside this tube a tar pipe was carried to the upper tray. The tar ran over this tray in a thin film and at the end of one circle it dropped from the edge of the tray on to the highest part of the tray immediately below; on this second tray its direction was reversed, and so on till it reached the bottom where it was beaten up into a spray by paddles mechanically driven.

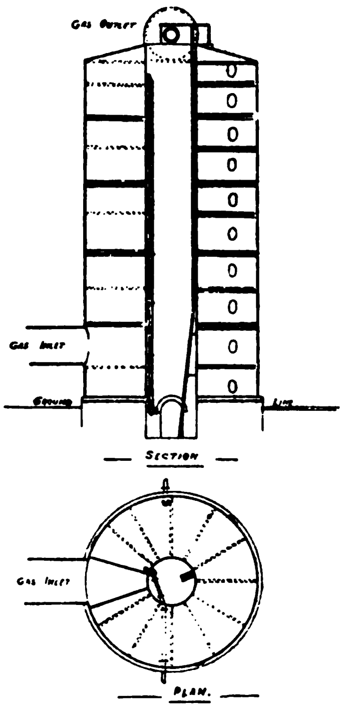


FIG. 1.

The tar washer now in use in several works is made in various sizes to suit its varying amount of work. It is divided longitudinally by three vertical partitions, one of these being closed at the bottom and open at the top, and two open at the bottom but closed at the top. It is divided also by a horizontal partition plate in which there are many openings; beneath and around these openings are formed seal or baffle plates which project downwards; the openings on one side of the first partition plate do not correspond in position with those on the other side of the same partition plate. The action is this, gas passing down through these inlet openings must pass round the lower edge of the seal plate before it can issue from the outlet opening, and if the seal plate is immersed in tar the gas must wash through the tar. The greatest care must be taken that the lower edges of these seal plates are perfectly level, as any variation in level will destroy the action of the vessel, if any part has less seal than the rest, the gas seeking the line of least resistance will pour through that point in a stream of considerable depth instead of passing through below the edges in a very thin film. Formerly these seal plates were made with serrated edges as it was thought that numerous small streams were the best means of washing the gas, but if care is taken about the levels there is certainly more washing edge in the solid casting. The washer, which has been described, has a washing edge of 1,500 ft.

The tar is run away from the lowest levels at each end, and passes through a sliding pipe which can be raised or lowered to suit the seal required inside. The simpler the piping arrangements for the tar run off the better, as it is very liable to set hard and choke up everything it passes through. The tar which has been pumped into this vessel as moist raw tar is now ready for distillation and should be kept separately for supplying the tar stills. On this tar washer, all provision possible should be made for cleaning, more especially on the inlet side. At two works, at present, preparations are being made for duplicating the tar washer and an arrangement of seals which will enable either washer to be put out of action, for cleaning forms a part of the scheme.

CONDENSERS.

The final cooling of the gases has been done by atmospheric condensers in nearly all the Scotch works, if not in all. In the type of condenser erected in several recent works, the boxes are of the same general dimensions and are proportionate in number to the volume of gas to be dealt with. The bottom chests are of cast iron and so divided transversely as to cause the gas to ascend and descend the pairs of tubes. These tubes are made of wrought iron riveted and made tight with insertion of tape at the joints. The condenser as a whole is bound together at the top by a system of angle and tee steel bars, which, besides acting as binders, form the carriers for a platform round all the tubes for convenient access to the water spray cocks.

At one time seals and baffles were introduced at the inlet and outlet of each chest, as a means of isolating any chest or chests for repairs, but these baffles were abandoned as they formed an inconvenient receptacle for dust and tar, and became an added anxiety to the ammonia works manager with little or no service. Again another idea was introduced by placing butterfly valves at the inlets and so directing the currents of gas through the condensers that each chest should do as much work as its neighbours. It was found that the vagaries of the gas in choosing certain lines of travel and in changing these lines of travel through chests and tubes were as endless and as unaccountable as the changes of the weather in the West of Scotland. The butterfly valves are, I think, a thing of the past.

In nearly all these atmospheric condensers an arrangement for spraying water over the tubes is added. It is a disputed point whether the water should be sprayed directly on to the tube, or whether it is as effective to allow the water to fall in a shower between the tubes so creating a movement in the air among them. There is no doubt that movement of the air is an effective assistance in the cooling, as the efficiency of a condenser is much greater on a breezy day of moderate temperature than on a still day of comparatively low temperature.

To arrive at a proper amount of cooling surface for such a condenser is a matter of difficulty. The area that would be sufficient in an exposed situation would not be at all adequate for a sheltered site surrounded with public works. Difference in site makes great difference in the efficiency of an atmospheric condenser. Again an important factor in the estimate of size is the amount of moisture in the coal and ore, which is converted into steam and requires condensation. It is wise policy after all considerations, to keep the condenser of ample size. A very rough approximate is to allow two chests for every furnace, each chest consisting of 16 or 18 pairs of tubes 54 ft. high. In the condenser at Coltness Iron Works there are over 6¼ miles of 20-in. vertical pipes.

From each chest the tar is drained away at one end, the lower part of the box being common throughout, the divisions only filling part of the cross section of the box. The tar from the various sections is run into one common pipe, and into a separator where, by means of baffle plates and sliding valves, the tars of two densities and the liquor are separated out, the one from the other. The greater bulk of the tar from the condenser is heavy and sinks below the liquor in separation.

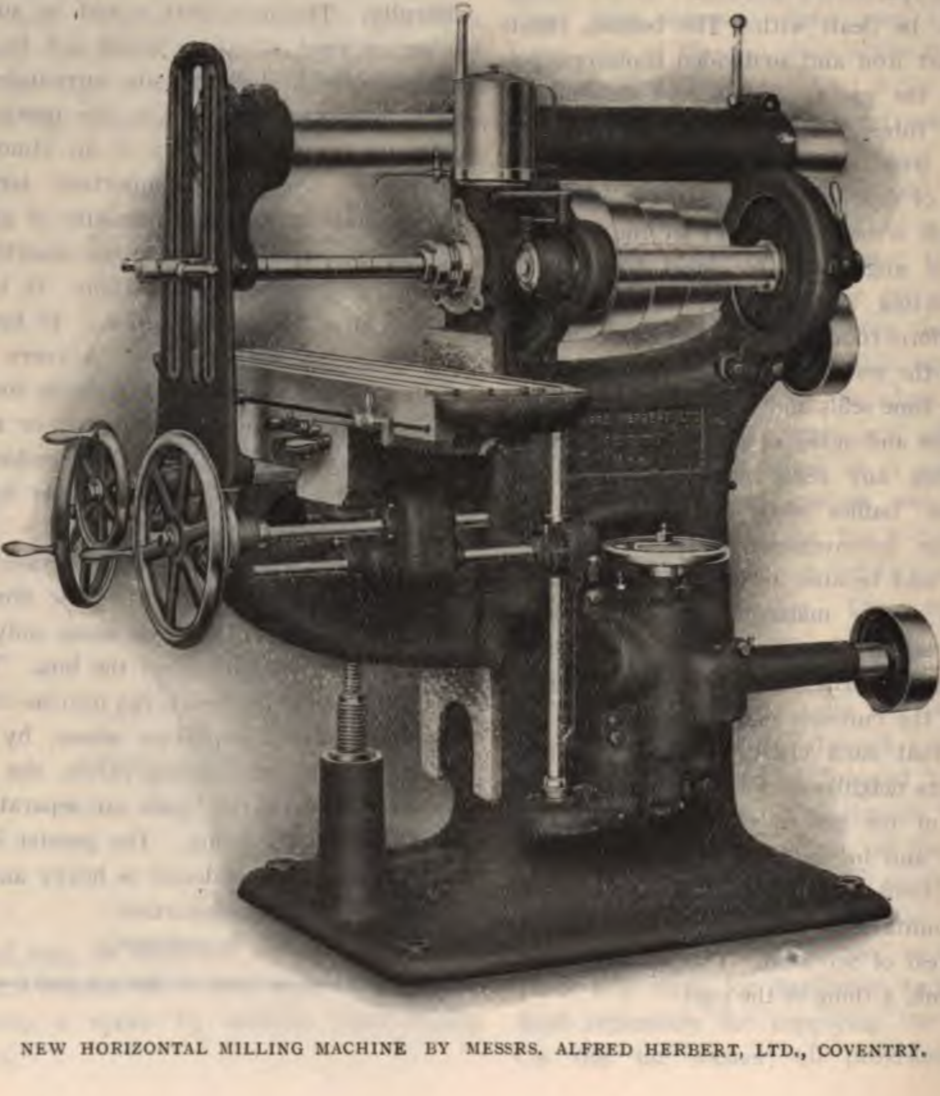
(*To be continued.*)

Abstract of a paper read before the West of Scotland Iron and Steel Institute.

A NEW HORIZONTAL MILLING MACHINE.

WE illustrate herewith a new plain milling machine which has recently been brought out by Messrs. Alfred Herbert, Ltd., Coventry. The illustration gives a good idea of the general appearance of the machine, and it will be noticed that in the main it conforms to the generally accepted practice. A considerable amount of attention has, however, been given to the easy manipulation of the machine on the part of the operator, and to the completeness of the feed range. The leading dimensions are as follows: Longitudinal feed, 34 in.; cross movement, 9 in.; vertical adjustment, 20 in.

The overhanging arm is a solid steel bar of large diameter. The arm brace is a single casting, rendering it very rigid. The spindle has a long conical bearing in front and an adjustable parallel bearing behind, and may be adjusted for diameter or thrust independently.



NEW HORIZONTAL MILLING MACHINE BY MESSRS. ALFRED HERBERT, LTD., COVENTRY.

The table is exceptionally deep and is lubricated from the front, so that it is not necessary to remove the vice or other fixture when the table requires oiling.

The table is fed by a screw which does not rotate, is not splined, and is always in tension. The movements of the table, cross-slide and knee are controlled by three handwheels all within easy reach of the operator without moving from the working position. The handwheel on the right moves the table longitudinally, and by means of gearing gives a very fast travel. The handwheel in the middle is for the cross adjustments, and that on the left-hand side for the vertical adjustments. All these movements are provided with graduated dials reading to ·001 in. The elevating screw is telescopic, so that it is not necessary to cut a hole in the floor.

The firm's new patent dial feed motion by which the change from any one feed to another is obtained by simply turning the handwheel is fitted to this machine. On a disc attached to the handwheel are stamped the various feeds, to obtain any one of which it is merely necessary to turn the disc round until that feed is opposite a pointer.

The feed is arranged so that it may be driven from the spindle or direct from the countershaft, and the disc is stamped with two sets of feed-ranges, when driven from the spindle in inches per revolution, and when driven from the countershaft in inches per minute. When the feed is driven from the spindle the driving pulley is geared to revolve twice the spindle speed, so that the feed belt which is very wide has a high velocity. Messrs. Herbert recommend the feed of all milling machines to be driven direct from the countershaft, and follow this practice in their own works, where they have some 50 machines, both horizontal and vertical, in operation. It will be noticed that there are no telescopic shafts or universal joints used in the feed transmission gearing.

The knee is a box casting entirely closed in on the underside and having a bearing on the column carried up above the horizontal surface of the knee. This form of knee, although more expensive to machine, is more rigidly supported than where the bearing on the column finishes below the horizontal surface. The cross-slide is unusually long forming a very efficient support to the table.

The whole design of the machine bears witness to careful thought and is pleasing in its effect. Three sizes of this machine, including a smaller and a larger one, are at present being built ; the method of manufacture is on strictly modern lines, all machine work being done to jigs and templates, and all cylindrical work that fits being finished on dead centres by grinding.

From April 1st the letter-postage to Australia will be reduced to one penny per half-ounce, and from the same date, the postage from Australia to the United Kingdom will be reduced to twopence per half-ounce.

Messrs. Vickers, Sons and Maxim are considering an important scheme, having for its object the education of their apprentices. In future all apprentices in the engineering and ordnance departments will have to pass examinations in algebra, geometry, reading, writing, and arithmetic. Apprentices are to be advised to attend technical schools, and any successes gained will carry increased wages and a later hour for starting work in the mornings. Promotion to the drawing office is contingent upon attendance at technical schools. The scheme will cost £900 a year.

At the meeting of the Institution of Electrical Engineers last Thursday, Mr. Alexander Siemens announced that the McMillan Memorial Fund, amounting to £2,082, had now been invested in trustee securities for the benefit of Mrs. McMillan and her children. The trustees appointed by the Council are Sir William Preece (Vice-President), Mr. R. Kaye Gray (Vice-President), and Mr. Siemens himself. The President said that Mrs. McMillan, finding it impossible to thank individual subscribers, desired to say that she hoped that the members would accept her thanks, expressed through him, for their kindness in the matter.

OUR WEEKLY BIOGRAPHY.

SIR WILLIAM CROOKES, F.R.S., D.Sc.

PROMINENT among the names of the scientists of the Victorian era who still continue to take an active part in the scientific progress of to-day, is that of Sir William Crookes, whose career is inseparably associated with many discoveries of far-reaching importance. Born in London, June 17th, 1832, at the age of sixteen he entered the Royal College of Chemistry as a pupil to Dr. Hofmann, and in 1849 he gained the Ashburton scholarship. The following year he became his instructor's assistant, and in 1854 he was appointed superintendent of the meteorological department of the Radcliffe Observatory at Oxford—a post which he eventually relinquished in order to devote himself exclusively to the study of chemistry.

SIR WILLIAM CROOKES, F.R.S., D.SC.

He was elected a Fellow of the Chemical Society in 1857, and two years later he founded the "Chemical News," of which journal he is the proprietor and editor. In 1861 he discovered a new metallic element which he called thallium; the following year the first piece of this metal was shown at the great exhibition in London. The next eight years were mainly devoted to the elucidation of the chemical properties of the new element. The results of his investigations were communicated to the Royal Society, of which he was made a Fellow in 1863, and later he received the royal medal for this discovery, and for his investigations on repulsion resulting from radiation. In 1875 his observations of the anomalous action of the weighing of thallium compounds in highly rarefied atmospheres resulted in the invention of the radiometer; the same year he was elected vice-president of the Chemical Society.

Sir William Crookes has upon three occasions had the honour of delivering the Bakerian lectures before the Royal Society; before the British Association he gave a lecture on "Radiant Matter," in which were embodied the results of his researches on the electric discharge in high vacua. The French Academie des Sciences in 1880 awarded him a gold medal and a premium of 3,000 francs in recognition of his discoveries in molecular physics and radiant matter. He acted as a juror in 1881 at the International Exhibition of Electricity held in Paris, and although his official position precluded his obtaining an award, the report of his fellow jurors, after considering, the merits of four systems of incandescent lamps, stated that none of them would have been successful except for the extreme vacua which Sir William Crookes had shown how to manipulate.

In 1885, for his improvements in apparatus for the production of high vacua, and for his invention of the radiometer, the Society of Arts awarded him the Ferguson medal. The next year he was elected president of the B. Section of the British Association and vice-president of the Society of Telegraph Engineers and Electricians. In 1888 he received the Davy medal from the Royal Society. and in 1887 and 1888 occupied the presidential chair of the Chemical Society, when he further expounded the theory advanced at the Birmingham meeting of the British Association on the genesis of so-called elements by a process of evolution from a primordial matter or "protyle." Many of the views then set forth by Sir William and experimentally demonstrated by him a year later, are now—as recent developments prove—generally adopted by the scientific world.

As will be remembered, Sir William Crookes is the inventor of the Crookes tube which was employed by Professor Röntgen for the discovery of X-rays; he is responsible for the discovery of the sodium amalgamation process of separating gold and silver from their respective ores; he is also interested in the manufacture of beet sugar, in dyeing and calico printing, and the derivations of anthracene, while on sewage problems and artificial fertilisation he is regarded as a foremost authority.

In recognition of the eminent services he had rendered to the advancement of scientific knowledge, in 1897 the late Queen bestowed upon him the honour of knighthood. He was president of the British Association in 1898; his address on that occasion dealt with the artificial fixation of atmospheric nitrogen and its application to the soil in order to increase the production of wheat. In view of the fact than many of his researches had proven advantageous to arts and manufactures, the Society of Arts, in 1899, bestowed upon him the Albert medal. The following year he added the spinthariscope to his list of discoveries, and was appointed honorary secretary of the Royal Institution. Last year he was the recipient of the Copley medal from the Royal Society.

In addition to editing a number of well-known books, Sir William Crookes is the author of several authoritative works, the divergent nature of which demonstrates the wide comprehensiveness of his scholastic attainments.

LAUNCHES.

Messrs. Doxford and Sons, Ltd., of Pallion, have successfully launched another large twelve-masted turret steamer, the ss. *Torrington*, built to the order of Messrs. W. J. Tatem and Co., Cardiff. The vessel is a duplicate of the ss. *Wellington*, which left the berths a month ago. The length of the *Torrington* is 390 ft., the breadth 55 ft., and the moulded depth 30 ft. Ten large winches are provided for rapidly dealing with the 9,000 tons of cargo carried, and an exceptional arrangement of six pairs of side masts will further greatly facilitate the loading and disdischarging with resultant economy in dock dues, etc. The engines and boilers are supplied by Messrs. Doxford.

On Wednesday, the 22nd inst., there was launched from the yard of the Tyne Iron Shipbuilding Company, Ltd., of Willington Quay-on-Tyne, the steel screw steamer built to the order of Wilh. Wilhelmsen, Esq., of Orsnoes, pr Tonsberg, Norway, and of the following dimensions: length, 355 ft.; breadth, 50 ft.; depth, moulded, 30 ft. 6 in., and to class 100 A1 at Lloyd's on the spar-decked rule. The engines, which are to be supplied by Messrs. Blair and Co., Ltd., of Stockton-on-Tees, are of the triple-expansion type, having cylinders 25 in., 42 in., and 68 in., by 45 in. stroke, and working at a pressure of 180 lb.

Messrs. William Gray and Co., Ltd., launched, on Wednesday, March 22nd, the large steel screw steamer *Gorgistan*, built for Messrs. Frank C. Strick and Co., Ltd., of Swansea and London. The vessel will take the highest class in Lloyd's, and is of the following dimensions, viz., length over all 384 ft. 6 in., breadth 50 ft. and depth 30 ft. The vessel has a cellular double bottom and after peak tank for water ballast, and in addition there is a deep tank or hold compartment fitted for water ballast abaft the engine-room, giving a total capacity for water ballast of about 2,000 tons. The decks are of steel and iron, and all weather decks, except in wells, are sheathed with teak, and the whole of the outfit, including steam windlass, steam steering gear, ten steam winches with return exhaust to winch condenser, and marine type donkey boiler, are of the most approved description. Porter's patent derrick sockets are fitted for dealing with heavy lifts. The machinery is made by the central marine engine works of the builders', being of the triple expansion type, with cylinders 28 in., 46 in., and 77 in., with a piston stroke of 48 in. She is fitted with Weir's feed-pump and heater and two large steel multitubular boilers working by Howden's forced draught at a pressure of 180 lb. per square inch.

AMERICAN LOCOMOTIVE CONSTRUCTION.

TENDENCIES IN MODERN PRACTICE.

THE AMERICAN LOCOMOTIVE OF TO-DAY.

THE loading gauge of American railways permits of the use of rolling stock of large size; the extreme width is often more than 10 ft., and the extreme height of the chimneys of some engines is over 15 ft. The weight of rolling stock of this kind is naturally considerable.

Helped by the possession of a loading gauge of such dimensions, and being able to find work for a great many very big locomotives both in goods and passenger traffic, the American designers show in their work the most striking example of the modern tendency towards building engines of size and power as great as are compatible with the nature of the lines over which they are to run. Big modern engines with their tenders frequently weigh in working order as much as 150 tons; this weight, spread over a total wheel-base of about 60 ft. is by no means small, but when the weights put upon the driving and coupled wheels are considered, the figures are much more striking. Eight coupled goods engines have as much as 90 tons upon the coupled wheels, extending over a wheel base of no more that 17 ft., and some four-coupled express engines have 27 tons upon the driving wheels and 25 tons upon the coupled wheels. The power of the boiler is commensurate with the weight of the engine, the grate area being often more than 50 square feet, and the total heating surface between 3,000 and 4,000 square feet.

FIREBOX CONSTRUCTION.

In order to get so large a grate area it is necessary to make the firebox very wide; it is therefore spread out above the frames and wheels. With grates up to about 6 ft. wide there is still room to construct a cab of the ordinary pattern, from which the driver can get a sufficiently good view of the line in front of him. Sometimes grates much wider than this are used, and it is then necessary to put a cab for the driver on the barrel of the boiler, while the fireman occupies the usual position. This involves separating the men—a most undesirable arrangement—and this construction is therefore not much favoured. As the grate has to be above the trailing wheels the firebox must be made shallow, and there is often no room for a brick arch, or any arrangement of that nature. The back of the firebox often slants backwards from top to bottom, to enable the fireman to deal more easily with a long grate. Both firebox and firebox shell are usually round topped; Belpaire fireboxes are largely used by the Pennsylvania Railway only. The round-topped arrangement facilitates the removal of scale and dirt when the boiler is washed out. Fireboxes are invariably made of steel; if the sheets are bent to a sufficiently large radius at the angles, they appear to give little trouble by cracking and will last two years in ordinary work before requiring heavy repairs. The stays are pitched at about 4 in. spaces.

BOILERS, ETC.

The centre line of the boiler is frequently as much as 9 ft. 6 in. above the rails. The barrel of the boiler is made of two, three, or four steel plates riveted one inside the other, the one nearer the smoke box inside, the one further away from it; one of the barrel plates is usually taper, and the firebox shell is usually taper also. The largest internal diameter of the boiler barrel is sometimes more than 7 ft. The tubes, also of steel, are, as a rule, 2 in. in diameter, except when they are very long—18 ft. to 20 ft.—when they are generally 2¼ in. in diameter. At the firebox end the tubes are fixed into the tubeplate by copper ferrules being interposed between tube and tubeplate, after which the tubes are expanded in the usual way. There is a dome a short distance in front of the firebox. The safety valves are usually placed above the firebox; they are generally set to blow off at about 200 lb. per square inch in simple engines, and sometimes at as much as 225 lb. in compound engines.

The frames are composed of a series of more or less parallel bars of rectangular section, arranged one above the other and joined together at intervals to secure sufficient stiffness. The cylinders are placed outside the frames (in some new compound engines there are inside cylinders as well). Their centre line is generally an inch or two above the centre of the driving wheels. The slide valves are usually of the balanced type, placed above the cylinders and worked through rocking levers from valve gear of the Stephenson pattern. Piston valves are also used to a certain extent, generally with interior admission; they seem to give satisfactory results without any special arrangements being made to allow of the release of water trapped in the cylinders. All the weight of the revolving parts and about two-thirds of the weight of reciprocating parts is usually balanced by revolving weights in the driving and coupled wheels. Some designers calculate the proportion of the weight of the reciprocating parts to be balanced by deducting a certain part of the total weight of the engine from the weight of these parts and then balancing the rest. A certain proportion of the balance weight is put in each of the driving and coupled wheels, but a greater proportion in the former than in the latter.

COMPOUNDING.

The great majority of engines are simple, but various types of both two and four-cylinder compound engines are in use. Two-cylinder compound engines are not much more complicated than simple engines; they are probably a little more expensive to build, and a little more troublesome to work, and superior economy in fuel is practically the only advantage aimed at in using them. Four-cylinder compound engines, however, are different, and, if the cylinders and motion are suitably arranged, they have, besides the advantages of economy the further advantage of imposing a much less severe strain on the road than two-cylinder engines with the same weight upon the driving wheels.

With the American four-cylinder designs, till quite recently, the two cylinders on either side were always placed one behind the other, or one below the other, and, in either case the high-pressure and low-pressure pistons on the same side of the engine moved in the same direction at the same time. If the high-pressure and low-pressure pistons on the same side move in the same direction at the same time, they do not balance each other, and, as with four cylinders, the weight of the reciprocating parts is greater than with the two-cylinders, the disturbing force due to the motion of these parts is, in comparison with a two-cylinder engine, increased instead of diminshed; the American designers, clinging to simplicity, did not for a long time try to secure what is probably the chief advantage of the four-cylinder system. Quite lately, however, four-cylinder compound engines have been introduced with one pair of outside and one pair of inside cylinders, the two sets of reciprocating parts on either side of the engine being made approximately to balance one another by the cranks being set at 180 deg. There are various designs of engine embodying this idea; one of them (built on the de Glehn system, and almost precisely like the latest engine on the Paris-Orleans line) has been imported from France. The indications are that these engines will prove successful. Equalising levers are employed generally in connection with the springs of all the wheels.

The smoke-box is cylindrical, and of considerable length. For the purpose of preventing the throwing of sparks, there is in it a baffle-plate, fixed obliquely in front of the tubes, against which the sparks strike, and there is also a wire netting to fill up the space between the baffle-plate and the front end of the smoke-box. The blast pipe is often double, the exhaust from each cylinder escaping by a separate nozzle, but lately the practice has come in of using the blast-pipe, with a single nozzle, the advantage of which is that it can be set perfectly central to the chimney. The blast-pipe orifice is not variable. A single-nozzle blast-pipe for an express engine, with 21-in. cylinders and 50 square feet of grate, would, under ordinary circumstances, be given an orifice about 5¾ in. in diameter.

The cab is very big, but the fire-box often takes up so much space inside it that there is not a great deal of room left. The driver has a seat on the right-hand side; the handle of the pull-out regulator is within easy reach, and the reversing level is close by him, so he can remain seated the whole time.

RECENT IMPROVEMENTS.

Except shunting engines, practically all engines have either a leading bogie or a leading radial axle. The bogie is generally of the swing-link type, but lately some have been built with the side-play, controlled by means of springs, with which arrangement it is considered that the front end of the engine is less free to swing from side to side. The driving wheels of four-coupled express engines are generally between 6 ft. 6 in. and 7 ft. in diameter, of goods engines about 5 ft. The commonest type of passenger engine has a leading bogie and four wheels coupled behind, more than a quarter of the total number of engines in the country being of this design. Of late, in order to be able to get in a bigger grate, many four-coupled express engines have been built with ten wheels, a small pair of trailing wheels being added under the footplate; engines of this design are sometimes fitted with an arrangement for taking some of the weight off the uncoupled wheels, and throwing it on to the coupled wheels at starting. The commonest type of goods engine has ten wheels, eight coupled behind, with a small pair of leading wheels, but there are a great many eight-wheeled six-coupled goods engines. There are also a very large number of ten-wheel engines, with a leading bogie, and six wheels coupled behind, the diameter of the coupled wheels being anything up to 6 ft. 6 in. Lately some twelve-wheel engines have been built for express work, with a leading bogie, six-coupled wheels of large diameter, and a small pair of trailing wheels. Shunting engines have four or six wheels, all coupled. Tank engines are very few in number; it seems to be thought difficult to provide a tank large enough to enable the engines to remain at work a sufficiently long time without stopping to take water. Some shunting engines are provided with tanks carrying 3,700 gallons of water. The tenders used with express engines, even when fitted with a water scoop, are built with a capacity of 5,000 gallons. As there is often room for ten tons of coal as well, the total weight of a loaded tender is frequently as much as sixty tons. The tenders almost always run on two four-wheel bogies; on those used with shunting engines, the tank slopes downwards towards the back end, so that the driver may get a better view when running tender first.

A fair price for a big eight-coupled goods engine with tender complete would be £3,700, and for a big ten-wheel four-coupled express engine a little less. In regions where oil is cheap a great many engines are run with oil fuel alone. The water before being supplied to the tenders is often chemically purified.

ELECTRIC TRACTION.

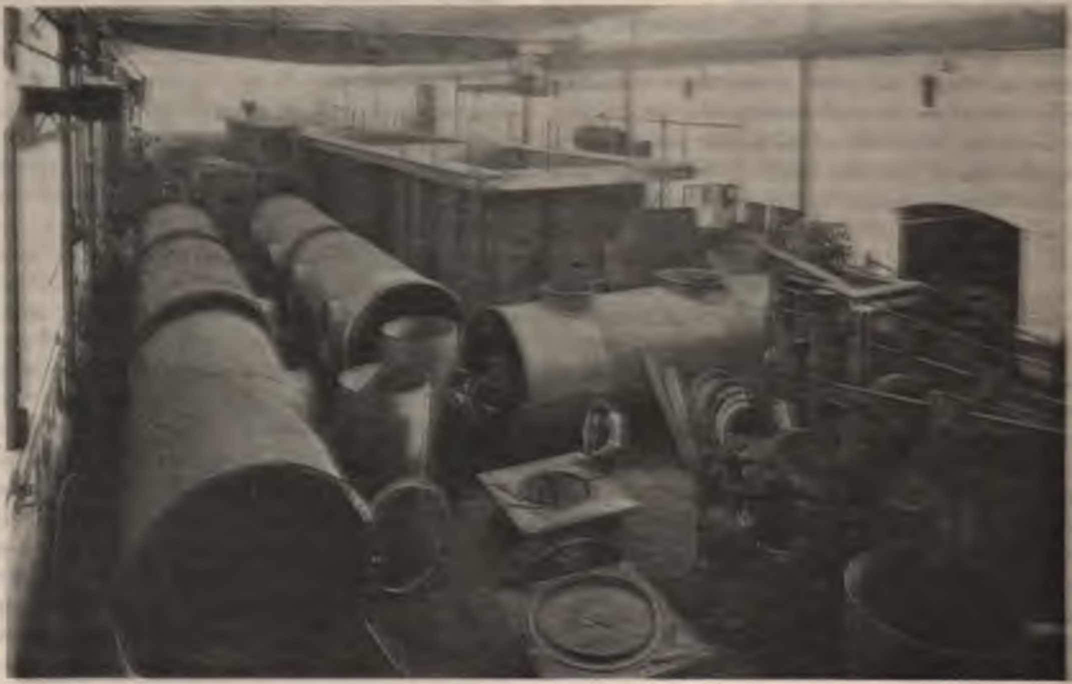
While electricity is almost exclusively used as the motive power of the extremely numerous tramways in every part of the country, on railways it is used to a very limited extent only; the overhead railways of New York and Chicago are the most conspicuous instances. For working trains through tunnels where the traffic is intense, and for suburban work in general, it is probable that electricity will be more and more used as the motive power, but the prospect of anything like a revolution in the direction of its being employed to work long distance railway traffic seems remote.

LOCOMOTIVE PERFORMANCES.

Two journeys were performed on the footplate for the purpose of making direct observations of the work of the biggest express engines: 1, with a very fast train; 2, with a very heavy train.

(To be continued.)

From a report by the Hon. Robert Collier, Third Secretary in His Majesty's Embassy at Washington.



A RANGE OF SIX DUFF PATENT TWIN GAS PRODUCERS CONSTRUCTED FOR THE DUNDERLAND IRON ORE COMPANY, LTD.

For gas firing the revolving furnaces used by the Company at their works in Norway for drying iron ore briquettes. The plant is shown in course of construction at the works of W. F. Mason, Ltd., Alma Works, Levenshulme. It will be capable of gasifying nine tons of coal per hour, and will be erected complete with elevating and conveying plant designed to deal with ten tons of coal per hour. Over each producer a storage bunker will be erected capable of holding forty tons of coal. Each producer is 23 ft. long, 11 ft. wide, and 11 ft. high. The gas tubing for conveying the gas from the producers to the furnaces, some of which is shown in the photograph, is 6 ft. 6 in. in diameter.

Temperature Experiments on Field Coils of Electrical Machines.

ENGINEERING STANDARDS COMMITTEE'S REPORT.

THIS, the latest report of the Engineering Standards Committee, is on an elaborate scale, and bespeaks great thoroughness on every page. The electrical plant committee responsible for the report is constituted as follows:—

Sir William Preece, K.C.B., chairman; Commander H. W. Richmond, R.N., Mr. C. H. Wordingham, and Mr. L. J. Steele, representing the Admiralty; Colonel H. C. L. Holden, R.A., and Captain A. H. Dumaresq, R.E., representing the War Office; Mr. A. P. Trotter, representing the Board of Trade; Mr. J. Gavey, C.B., representing the Post Office; Dr. R. T. Glazebrook, representing the National Physical Laboratory; Colonel R. E. B. Crompton, C.B.; Major Philip Cardew, R.E. (ret.); and Messrs. W. A. Chamen, Philip Dawson, S. Z. de Ferranti, Robert Kaye Gray, Mark Robinson, R. Percy Sellon, Alexander Siemens, John F. C. Snell, Charles P. Sparks, and James Swinburne; Mr. Leslie S. Robertson, M.Inst.C.E., is of course, the secretary; the electrical assistant secretary being C. le Maistre, A.M.Inst.E.E

In the standardisation of electrical machinery, the permissible temperature rise is one of the most important points to be decided, and the Generator Sub-Committee (Colonel R. E. Crompton, C.B., chairman), who have this matter under consideration, felt that no recommendation upon this particular subject could be arrived at until reliable experimental data had been obtained. It was decided to request the National Physical Laboratory to undertake this investigation, and the Sub-Committee on Physical Standards was formed to assist and consult with Dr. Glazebrook. It is confidently hoped that the results of these experiments, which, through the courtesy of the manufacturers, the committee have been enabled to carry out, will prove of material assistance in bringing to a successful issue the committee's deliberations with regard to the temperature rise to be recommended in electrical machinery.

The Committee tender their thanks to the director of the National Physical Laboratory, to Mr. E. H. Rayner, who carried out the experimental work under Dr. Glazebrook's direction, and to the staffs of the various manufacturers for their practical assistance during the actual running of the tests. Thanks are also tendered to the following manufacturers: Messrs. The British Electric Transformer Co., Ltd., the British Thomson-Houston Co., Ltd., the British Westinghouse Electric and Manufacturing Co., Ltd., Bruce, Peebles and Co., Ltd., Crompton and Co., Ltd., Dick, Kerr and Co., Ltd., Johnson and Phillips, Mather and Platt, Ltd., Siemens Bros. and Co., Ltd., and Willans and Robinson, Ltd., for their kind co-operation in building the test coils, and so furthering the work of the committee.

OBJECT OF THE EXPERIMENTS.

The main object of the experiments has been to determine generally the relation between the maximum temperature in the interior of any coil, taken by means of a thermo-junction, and the mean temperature of the same coil taken by rise in resistance. The determination of the mean temperature of any coil is a comparatively easy matter, it may be quite accurately obtained from the increase of resistance of the copper composing the winding. It is, of course, quite obvious that the outside of the winding must be at a lower and that part of the inside must be at a higher temperature than the mean.

The highest temperature and the corresponding mean temperature have been determined for the committee from experiments carried out on field coils of various sizes kindly made by different manufacturers, under actual running conditions, and also at the National Physical Laboratory. A paper entitled, "The Rise of Temperature in the Field Coils of Dynamos," by E. Brown, M.Sc. (Proceedings of the Institution of Electrical Engineers, 1901, Part 152, Vol. XXX.), was consulted, and, although the field coils experimented upon were those of a small two-pole machine, the diagrams there given were of considerable assistance and served as a basis for determining the probable position at which the highest temperature might be expected to occur.

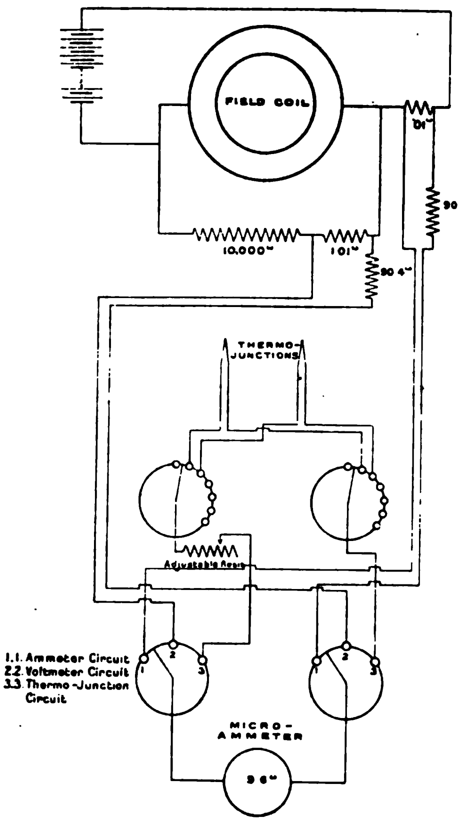
THERMO-JUNCTIONS.

A thermo-junction of iron-eureka was employed in measuring the temperature, as this combination has a high thermo-electric voltage which is very fairly linear over the range required. The thermo-junction

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	
	Coil No.	Test No.	Res. Cold in ohms 0°C.	Res. Hot in ohms	Nominal Amps.	Amps. during Test	Standing or R. p. m. if Running.	Amps. per square inch.	Amps. per square m/m.	Watts.	Watts per square inch.	Watts per square c/m.	Watts per cubic inch.	Air Temp. °C	Temp. on Coil by Thermometer °C	Max internal Temp. °C.	Mean Temp. °C	Max. minus Mean. °C	Max. minus Air Temp. °C.	Max.—Air Temp. / Watts per sq. in.	Mean minus Air Temp. °C.	Mean—Air Temp. / Watts per sq. in.	Page.
2	1α	1α B	79·5	189·4	1·0	1·0	S.	800	1·25	110	·380	·053	·290	12	53·0	105·3	88	17·3	93·3	246	76	200	6
3	1β	1β A	61·6	85·50	1·3	1·29	R. Light 850	860	1·22	142	·490	·076	·508	13	50·5	106·0	90·5	15·5	93·0	190	77·5	158	7
4	1γ	1γ B	0·43	9·25	—	3·72	S	915	1·42	128	·442	·069	·460	18	74·5	115·6	101·6	13·4	97·0	220	83·6	190	8
5	,,	1γ C	,,	8·91	—	3·47	,,	850	1·32	107	·368	·057	·380	18	67·1	102·2	89·5	12·7	84·2	228	71·5	194	,,
6	,,	1γ D	,,	8·51	—	3·16	,,	780	1·21	86	·296	·046	·310	17	57·0	85·8	78·5	7·3	68·8	232	[illegible]	208	,,
7	,,	1γ E	,,	8·33	—	2·90	,,	710	1·10	70·4	·242	·035	·250	16	50·4	74·3	68·5	5·8	58·3	212	52·5	216	,,
8	,,	1γ F	,,	8·56	—	3·65	S. no core	900	1·40	115	·400	·061	·418	13·6	57·0	93·6	77·2	16·4	80·0	200	63·6	160	,,
9	1δ	1δ F	6·35	8·00	—	3·66	,,	900	1·40	107	·370	·057	·380	13·6	49·0	68·5	60·5	8·0	54·9	150	46·9	127	,,
10	2	2A	15·31	22·2	4·0	4·5	R. at F.L. 325	980	1·51	407	·686	·105	·473	21	55·0	126·5	105	21·5	105·5	153	84	121	9
11	,,	2B	,,	21·6	,,	,,	R. Light 310	980	1·51	400	·667	·102	·465	21	32·0	116	96	20·0	95·0	142	75	112	,,
12	,,	2C	,,	22·15	,,	3·32	S. core used.	755	1·17	244	·406	·062	·284	15	81·0	121·4	104·2	17·2	106·4	262	89·2	219	,,
13	3	3A	31·5	41·0	2·0	2·0	R. at F.L. 600	1,100 945	1·71 1·46	184	·342	·052	·310	21	44·0	93·8	70·3	23·5	72·8	212	49·3	144	10
14	,,	3B	,,	41·2	,,	1·68	S. core used.	780	1·21	113	·240	·037	·217	12	49·0	92·4	71·6	20·8	80·6	335	59·6	250	,,
15	4	4A	35·2	52·2	1·7	1·52 varying.	R. at F.L. 265–360	840	1·30	120	·354	·053	·240	27	69·0	110·3	107	3·3	83·3	235	80	226	10
16	,,	4B	,,	49·2	,,	1·54 varying.	,,	850	1·32	120	·354	·055	·240	30	75·0	96·8	92·7	4·1	66·8	188	62·7	177	,,
17	,,	4C	,,	50·7	,,	1·72	S. no core.	950	1·47	150	·440	·068	·300	19	59·0	106·8	103	3·8	87·8	200	84	191	,,
18	5	5A	3·81	4·78	,,	9·3 varying.	R.L.V. 180	650	1·01	400	·308	·048	182	19	41·0	67·0	59·5	7·5	48·0	156	40·5	132	11
19	6	6A	2·70	3·21	11·4	7·07	R.L.V. 340	350	0·55	161	·124	·019	·070	24	31·0	46·4	44·0	2·4	22·4	180	20	161	11
20	,,	6B	,,	3·28	,,	7·09	S coil on Machine.	350	0·55	165	·127	·020	·072	20	41·0	52·3	50·2	2·1	32·3	254	30·2	238	,,
21	,,	6C	,,	3·77	,,	11·12	S. no core.	555	0·86	467	·360	·030	·203	23	64·0	100·5	92·5	8·0	77·5	214	69·5	193	,,
22	7	7A	6·70	8·95	6·5	5·2	R. as Motor 108	640	0·99	233	·192	·030	·162	10	47·0 on series.	88·1	78·5	9·6	78·1	400	68·5	346	11
23	,,	7B	,,	8·48	,,	,,	S core used	640	0·99	230	·185	·029	·132	12	41·0	78·4	62·0	16·4	66·4	360	50·0	270	12
24	,,	7C	,,	9·7	,,	5·34	,,	800	1·23	415	·338	·052	·292	15	64·0	126·2	104·5	21·7	111·2	330	89·5	267	,,
25	8	8A	4·25	6·92	8·0	8·20	R. at F.L. 320	805	1·25	438	·380	·059	·260	26	31·0	102	86·0	16·0	76·0	200	60	155	12
26	,,	8B	,,	8·10	,,	11·1	,,	1,090	1·69	995	·836	·128	·562	26	47·0	180	144	36·0	154·0	186	118	142	,,
27	,,	8C	,,	7·44	,,	8·12	S core used.	795	1·22	468	·406	·063	·275	12	34·0	135·4	113	22·4	123·4	304	101	249	,,
28	,,	8D	,,	7·25	,,	7·50	,,	745	1·15	420	·359	·054	·237	13	51·0	131·6	106·3	25·3	112·6	326	87·3	249	,,
29	9	9A	·689	·874	[illegible]	[illegible]	R. Light 200	[illegible]	·91	315	·274	·012	·210	20	45·0	65·4	63·2	2·2	45·4	165	43·2	157	12
30	,,	9B	,,	[illegible]	,,	...	,,	,,	,,	293	·256	·040	·197	18·5	40·0	45·7	44·0	1·7	27·2	106	25·5	100	12

TABLE II. FROM THE REPORT OF THE ENGINEERING STANDARDS COMMITTEE, DEALING WITH TEMPERATURE EXPERIMENTS ON FIELD COILS.

DIAGRAM OF CONNECTIONS.



EXPLANATORY NOTES TO TABLE No 2

Column No 1. Coil number.
.. 2 Test number
.. 3. Resistance of coil cold, in ohms at 0° C
.. 4. Resistance of coil hot, in ohms.
.. 5 Nominal amperes.
.. 6. Amperes in coil during test
.. 7. Experiment carried out with machine running or on coil with its core, or alone, i.e.,
$\frac{\text{R at F.L.}}{325}$ = Running at 325 R p m at full load
$\frac{\text{R.L.V}}{180}$ = Running at 180 R p m, load varying.
$\frac{\text{R Light}}{310}$ = Running light at 310 R p m
$\frac{\text{S}}{\text{No core}}$ = Tested standing without the core
.. 8. Amperes per sq. inch
.. 9 .. per sq m m
.. 10 Watts
.. 11 Watts per sq inch
.. 12 .. .. sq. c·m
.. 13 .. .. cubic inch
.. 14 Temperature of air during test in °C
.. 15 Temperature on coil by thermometer in °C
.. 16 Maximum internal temperature C
.. 17. Mean temperature in °C calculated from the formula $R_{\theta} = R_{0}(1 + \cdot 00428\theta)$
.. 18 Maximum minus mean temperature
.. 19 Maximum minus air temperature
.. 20 $\frac{\text{Max.—Air temp}}{\text{Watts per sq. inch}}$
.. 21 Mean minus air temperature
.. 22 $\frac{\text{Mean—Air temp}}{\text{Watts per sq. inch}}$

In all cases temperatures given are actual temperatures in degrees Centigrade, and only where stated do the figures represent temperature rise

The figures given in Columns 20 and 22 are inversely proportional to the emissivity

consisted of No. 26 S.W.G., double silk-covered wires, silver soldered at the ends and bound together with silk, making a very compact and flexible arrangement for measuring temperature at a point.

GALVANOMETER EMPLOYED.

The actual reading of the temperature was recorded on an extremely sensitive moving-coil galvanometer made by R. W. Paul. This instrument was designed with a particular resistance and sensitiveness suitable to the special conditions under which it was to be employed. The highest reading on the scale was 0·0002 ampere and less than 0·002 volt. By the addition of a variable resistance in the thermo-junction circuit the instrument was calibrated to read direct in degress C., *i.e.*, the difference in temperature between the "hot" and "cold" thermo-junctions.

DESCRIPTION OF APPARATUS.

The "cold" junction was placed inside a box with fifteen pairs of terminals which at the same time was used as a multiple switch for the various thermo-junction circuits. A thermometer in the box gave the temperature of this cold thermo-junction and this, added to the deflection on the galvanometer gave the temperature in degrees C. The exact value of the resistance to be put in circuit to give direct readings in degrees C. was determined by heating a sample thermo-junction in an oil bath with a thermometer, and in this manner the accuracy of the readings has been frequently checked. Various resistances have been specially made to suit the galvanometer, in order to be able to measure the volts and amperes in the coil under test, which was, of course, requisite for calculating the mean temperature of the coil at any time. A three-way switch was used, by means of which the thermo-junction—, the volt—, or ampere—circuits could be connected to the galvanometer. Besides this, resistances were arranged in the box so as to measure the resistance of the field coils cold, at a definite temperature, by a bridge method, thus avoiding the use of a large current and consequent errors due to the heating effect during observation.

Special precautions were exercised to ensure equality of temperature in the coil when measuring the "cold" resistance, as on this figure the calculations for the mean temperature were based. In some cases it was even found necessary to cover the coil with a blanket for two or three days before concordant figures could be obtained. Care was also taken in arranging the resistances so that the galvanometer could be calibrated by an ordinary potentiometer.

This arrangement for reading the temperature, the amperes and the volts on the same instrument has been of great assistance, especially in the experiments conducted at the works of the various manufacturers supplying the coils. The sensitiveness of this instrument has very largely contributed to the accuracy and ease with which the results have been obtained.

A diagram of connections is reproduced showing the method adopted in carrying out the investigation. The apparatus was ready for use by simply moving the multiple switch to read (for instance: at the 100th division in the centre of the scale) 100 volts, or 1·0 ampere, or 100 deg. C. above the atmospheric temperature. The various other resistances were employed for giving other constants as desired. The figures for the temperature have been read to 0·2 deg., and the points on any curve are in themselves of this order of accuracy, but the actual position of the whole curve is in all probability only accurate to 1 deg. on account of various secondary errors due to temperature and stray magnetic field.

The general method adopted throughout the investigation has been to carry out a preliminary test at the National Physical Laboratory on the coils after which tests were made on the coils under actual working conditions at the manufacturer's works.

The excess of the maximum over the mean temperature varied according to the shape of the coil, and the temperature at which it was run.

A considerable cooling effect on the core side was noticeable in the case of some of the coils wound on a metal former, where there was an air space between the core and the coil, and consequently some of the curves obtained show nearly as low a temperature on the core side as on the outside, when the machine was running.

DETAILS OF COILS.

Coils Nos. 3, 5, 6 were wound on metal formers and merely varnished on the outside. Coil No. 7 was wound on a metal former, but covered to a great extent by the series winding. Coils Nos. 1α, 1β, 1γ. were wound on temporary formers and finished with tape and other insulating materials. Coil No. 4: the series winding on this coil was enclosed in the taping. Coil No. 8: a layer of string was added to this coil. Coil No. 9 was wound on a metal former, protective coverings being used.

All coils, except No. 4, were wound with double cotton-covered wire, the latter being wound with single.

The figures in column No. 18 of the accompanying table give the essential results of the investigation, and it will be noticed that the figures for the difference between the maximum and the mean temperature vary from about 25 deg. C. downwards. A value of 0·428 per cent. per degree C. has been assumed for the temperature co-efficient of the resistance of copper. This has been confirmed in the case of coil No. 3. The somewhat small difference between the maximum temperature found by thermo-junction and the mean temperature, calculated from the increase of resistance, which is noticeable in a few of the experiments may be due to this co-efficient not being exactly the value assumed.

The report has a valuable appendix concerning the actual temperature up to which cotton may be used. We hope to deal with this in a subsequent issue.

Shipbuilding Notes.

THERE was launched from the yard of Earle's Shipbuilding and Engineering Company, Ltd., Hull, on the 17th inst., the steam carrier ***Warter Priory***, which has been built to the order of the Hull Steam Fishing and Ice Company, Ltd. The vessel has been specially designed for the carrying trade between their fishing fleet and London. She is fitted with a whaleback which will give shelter for the crew, and will also shelter to a large extent the forward well deck. She has also a long raised quarter deck, with wheel-house and navigating bridge over same. A powerful trawl winch has been fitted, and traw-gear for one side of the vessel. The ice and fish rooms are of large size, insulated throughout. The dimensions of the vessel are 146ft. 8in. by 23ft. by 11ft. 9½in., moulded. The engines and boiler will be supplied by Messrs. C. D. Holmes and Co., Hull.

Messrs. Workman, Clark and Company, Ltd., Belfast, launched from their South Yard on the 21st inst., the first of two steel-screw steamers, which are being built by them to the order of Messrs. Elders and Fyffes (Shipping), Ltd., of London. The new vessel has been named *Pacuare*, and is specially designed and equipped for the conveyance of fruit in bulk between the West Indies, Costa Rica, and this country.

The *Pacuare* is one of the largest vessels engaged in the fruit-carrying trade, being 383 ft. in length, with a gross tonnage of nearly 4,000. She has four complete steel decks, extending fore and aft, and a top-gallant forecastle. The cargo space is divided into separate compartments by steel bulkheads extending to the upper deck, all these compartments being insulated, while a complete and efficient installation of refrigerating machinery will be fitted, having air ducts to convey the cool air to each compartment for the preservation of the fruit during transit.

CIVIL ENGINEERING.

The Assouan Dam.

The daily contemporary, which a few weeks ago put into large capitals the words, "Death Blow to Arbitration" upon receiving the first garbled report of the North Sea Commission, printed in a prominent position on the 25th inst., "Nile Dam in Danger: Alarming Scientific Discovery" (!). This is what Sir Benjamin Baker has to say about the "alarming" business in question, his remarks being based upon a recent inspection: "I found that the masonry protecting the bed of the river was standing the strain well. Where the rocky river bed was not so protected the water had torn many holes—in some cases 24 ft. deep. These do not at present affect the dam, for they are 40 or 50 ft. away from it. In the course of a few years they might extend closer to the base of the dam, were the masonry protection not completed. With this mischief caused by the present head of water, it would obviously be folly to raise the dam at once, and thus increase the force of the water by raising its level. This factor alone postpones any consideration of the raising of the dam for two years. As to the 'new theory' of the stresses to which masonry dams are subjected, advanced by Professor Karl Pearson, it is not so much a discovery as a development. Professor Pearson would apply it to all masonry dams, but I am not prepared to go so far as that at present, but we are both working at it. The two years' breathing space given us by the present necessary work will enable scientific men to make up their minds as to its application to the Assouan Dam.

New Docks for Antwerp.

Great activity is being displayed over the new docks (Bassins Intercalaires), which are at present in course of construction at Antwerp, and which are to be open and ready for traffic by May, 1907. These docks will cover an area of 333,301 square yards, and will be by far the largest docks in Antwerp. They are to be constructed at a cost of £300,000, and will have access to the river by means of the Lefebvre Dock, the entrance lock being 55 yards in width. The dock is to be made in two divisions, each of which will be rectangular in form, the two converging together at the entrance into a neck 98 yards wide. In the construction of this dock part of the existing chain of fortifications which encircle the town of Antwerp will have to be demolished, and re-erected at some distance. An additional area of 319 acres will thus be enclosed within the walls of the town. These docks will have a depth of water of 30 feet, and are to be so constructed that, should it be deemed necessary, the bed of the dock can be deepened by 3 feet. The work of construction, which was put up to public tender, is being carried out by an Antwerp firm. The top of the quay wall in all these docks is 11 ft. 10 in. above the normal water level. It is interesting to note, from the consular report from which the above is taken, that Antwerp shows every sign of maintaining her position as the third largest port.

Dover Harbour.

Since my last notes the eastern and western breakwaters of the Admiralty Harbour at Dover, have been completed within three days of each other. The works have been in progress for the past five years, and details, with illustrations, appeared in PAGE'S MAGAZINE for February, 1904. The breakwaters enclose a width of about one and a half mile, comprising over 600 acres of anchorage. The southern breakwater, 4,200 ft. long, which is rapidly progressing will complete this great national undertaking.

Manufactures of Greater Britain.

No. I.—CANADA.

A COURSE of lectures is being delivered before the Colonial section of the Society of Arts. The first lecture was by Mr. C. F. Just on the "Dominion of Canada." The following is an abstract of the engineering portions of the lecture:—

Canada's iron industry is represented by eighteen blast furnaces and several steelmaking plants, located at nine different points in Nova Scotia, Quebec, and Ontario. Of the importance of the hundred and one subsidiary industries dependent on iron and steel, the census returns furnish conclusive evidence. Of these the engineering industry is notable for its growth during the last five years, and for its ability now to undertake large and complicated work. Many new establishments are also under construction in most of the chief centres.

The iron and steel enterprises in Ontario at the Sault Ste. Marie and in Nova Scotia, at Sydney, were initiated, and are still largely supported by American capital. The Steel Trust of the United States is known to have made large purchases of mineral lands, and has arranged to put up an immense plant at Port Colborne, Lake Erie, to employ 3,000 hands. Another American enterprise is the Canadian Steel and Coal Company, with a capital of 6,000,000 dols., possessing large properties in iron ore and coal lands. Similar support is also being given to copper mining, and to developing oil wells, asbestos, mica, and nickel deposits, and to reduction works and other metallurgical processes.

It is no secret that much of this recent American enterprise in Canada is directly due to the British preference policy. Americans fear this policy, if pressed and developed, will result in the loss to them of much of their trade with the British Empire, and that Canada, with like resources, possesses exceptional opportunities for taking the place of the United States. "Forewarned is forearmed," and so during the last few years a systematic transfer of American manufacturing to Canada has taken place for the double event—*i.e.*, Canada's home and foreign markets. Leading American firms of agricultural machinery have united to put up jointly works employing thousands of hands at Hamilton, Brantford, Stratford, and Toronto for the home and export trade; sewing machine factories in Quebec; locomotive, rolling-stock and bridge-building works at Montreal and Toronto; general engineering works for the manufacture of machinery of all kinds.

American capital also is largely invested in the new Canadian power works at Niagara, Shawinigan, the "Soo," Fort William, and at other points.

THE COAL AND IRON INDUSTRY.

The determining factor in a nation's position in the world is held to depend ultimately upon the possession of coal and iron. In these essentials to a country's welfare, and its industrial potentialities, Canada is richly supplied. It is doubtful also whether there is any other country richer in gold and silver, in lead, copper, and nickel, and in the other principal metallic and non-metallic minerals, the fuller development of which must shortly command the attention of capital. The present ascertained coal areas of the Dominion are estimated at 97,200 square miles.

The iron ores of the Dominion are unquestionably of great extent and importance. In Nova Scotia iron ore is found in workable amounts in most of the counties; for all practical purposes, however, the enormous ore reserves of Newfoundland—still politically outside the Dominion—must be included among Canadian sources of supply. The most notable are the hematite deposits on Bell Island, estimated to contain 35,000,000 tons, the property of Nova Scotia ironmasters. In Quebec extensive deposits of magnetic iron-sand exist on the north shore of the St. Lawrence river, where it is estimated that many millions of tons of ore containing a high percentage of iron, and practically free from phosphorus and sulphur could be obtained by a good process of concentration. With regard to Ontario, it is doubtful whether in any part of America so great an extent exists of rocks favourable for the occurrence of ore deposits as in Ontario. . . . . Already a number of mines have been located both of hematite and of magnetite, and it need not be surprising if within the next five or six years mines are developed in northern and north-western Ontario. Indications as tested by the diamond drill, go far to establish the fact that the great iron ranges to the south and west of Lake Superior, whence the United States iron industry derives to-day 70 per cent. of its raw material, extend across into Canada.

STEEL MAKING PLANT EQUIPMENT.

In British Columbia, ore deposits of high quality are known to exist, and have been located in large bodies within easy reach of ocean transportation. Considerable quantities of these ores are already being exported to the iron industry of the United States on the Pacific Coast in competition with native ores, despite the tariff of 40 cents. (1s. 8d.) a ton to which such importations are subject.

To-day there is a capital of 40,000,000 dols. invested in Canadian iron and steel works, and in the iron mines of the country. Successive Canadian administrations, convinced of the necessity of the industry to the national growth, have given additional encouragement in the form of bounties on the production of pig-iron and steel billets. The industry has now reached an advanced point in its formative stage, and may at any time assume the ultimate form of a great industry.

The present equipment of the Dominion consists of four coke and six charcoal smelting plants, with a total capacity of 1,000,000 tons of pig-iron per year, and of five large steel-making plants, capable of producing 500,000 tons of steel annually. The works are at Sydney, New Glasgow, Londonderry in Nova Scotia, Radnor in Quebec, and at Deseronto Hamilton, Midland, Collingwood, and Sault Ste. Marie in Ontario. Certain of these plants have had their vicissitudes, but all are now successfully adjusting their output to local needs. The annual consumption of iron and steel in Canada is estimated to-day at 850,000 tons, with every prospect of a rapid increase. Local production at present is equal to about one-third of the actual capacity of the works referred to, the balance of Canada's total requirements being imported, as to 70 per cent. from the United States, and as to 30 per cent. from the United Kingdom.

The decision of the Government in 1904 to put a protective duty on steel rails—hitherto on the free list—must lead eventually to the production within the Dominion of the greater part of its rail-requirements. These requirements, for the present mileage—20,000 miles—are estimated at 200,000 tons annually, and with the new extensions in progress and planned, must increase rapidly. The only rail-mill in operation at present is at the Canadian "Soo," with a capacity of 500 tons a day; a second mill of 1,000 tons capacity will be completed in July next at Sydney in Cape Breton on tide water, where the largest and most ambitious Canadian iron and steel plant is situated. At this point the conditions of cheap production are admitted to be unequalled on the North American continent, perhaps in the world.

LOWER COST OF RAW MATERIALS.

Sydney's advantage over Pittsburg, U.S.A., lies in the lower cost of assembling the raw materials for producing a ton of pig-iron. Again, for the export trade Sydney has an advantage over Pittsburg of 460 miles land-carriage to the sea-board, and of about 1,000 miles of ocean-carriage so far as the European market is concerned. These conditions should always prove a great factor in securing for Nova Scotia a pre eminence in the production of iron and steel. The principal centres of consumption in Canada are in Ontario, and in this province the remaining iron and steel plants of the country are to be found, one of the first magnitude being, as stated, at Sault Ste. Marie. All these plants lie at, or near, lake navigation; they are designed to meet local requirements and the demands that may arise from new industries such as the construction of lake-shipping, which is now of immediate importance in view of the enormous tonnage which Western Canada is providing for transportation in Canadian bottoms to Canadian lake and ocean ports.

The day of the iron industry in British Columbia is not yet. However, the character of the development that lies before that province on the Pacific Ocean, its growing shipping interests, the exceptionally rich local iron and coal deposits, and the distance from the iron industry of Eastern Canada all suggest the probability of early action being taken.

Probably Canada's greatest industrial asset and the best guarantee of her industrial future lies in her unequalled water-power scattered by the prodigal hand of nature throughout her vast territory. The future industrial development of Canada will undoubtedly be closely associated with the utilisation of her water falls. It is chiefly, however, in connection with electro-chemical works that Canada may look immediately for the greatest return from water-power.

These possibilities flowing from the use of water-power are not merely in the air, but are now being realised in Canada on a large scale.

TECHNICAL SOCIETY NOTES.

REFERENCE was made in the last issue of PAGE'S WEEKLY to the opinion expressed in the official abstract of Lord Brassey's paper, "Shipbuilding for the Navy," that the discussions which take place from time to time under the auspices of the Institution of Civil Engineers were valuable for the guidance of public opinion. It was pointed out that it was not easy to see how public opinion was to be guided by discussions from which pressmen are rigorously excluded. There was the more point in this criticism, because although it is pretty common knowledge that Sir William White made a long and important contribution to the debate on Lord Brassey's paper at that adjourned meeting, not even the usual brief abstract of the proceedings has been issued to the press. Sir William White's opinions on a matter of important public policy, and on which he speaks with particular authority, will therefore be enshrined in the archives of the Institution of Civil Engineers until the next volume of the Transactions makes its usual belated appearance, when what should be news has merged into the domain of history.

The discussion at the Institution of Electrical Engineers on the papers of Mr. Rayner and Mr. Goldschmidt was lively and at times even amusing. It fell to Professor S. P. Thompson to open the discussion. He said that the former paper "On the effect of heat on the electrical and mechanical properties of dielectrics," dealing with the results of experiments at the National Physical Laboratory was a most important piece of work, and that all those whose business it was to calculate the duties that could be got out of electrical machinery, would appreciate what had been done, and appreciate it more and more as time went on. It was a veritable storehouse of facts, and as it was the first important communication which the National Physical Laboratory had made to the Journal of the Institution, they would look forward with pleasurable anticipation to future papers from the same source.

Professor Thompson then turned to Mr. Goldschmidt, and after expressing his admiration for his paper on the "Temperature Distribution in the Interior of Field Coils," proceeded to criticise it piecemeal, a process which can scarcely have been so entirely appreciated by the author who was sitting beside him as it seemed to be by the meeting generally. Happily there appeared to be nothing wrong with the author's general conclusions; he merely seemed to have arrived at them by processes which do not entirely commend themselves to the purely scientific mind, and indeed, the learned Professor hinted that in the effort to avoid mathematics, the author had adopted a method of reasoning which was even more difficult to follow. On all these little matters Professor Thompson proceeded to put the author right, and as Mr. Goldschmidt subsequently expressed his thanks he clearly took the criticism in the kindly spirit in which it was intended. Mr. Goldschmidt pointed out, however, that he had deliberately adopted approximate rather than mathematical methods in order to render the application of tests more easy in workshop practice, and on the more purely theoretical side he promises another paper. Other speakers expressed their keen appreciation of Mr. Goldschmidt's paper. Mr. Goldschmidt himself had some observations to make on Mr. Rayner's paper, which completed the chain of criticism.

The general opinion expressed with regard to Mr. Rayner's paper was that it was likely to prove very valuable. Mr. Hobart said the investigation would be of considerable service to designers and that the importance of the subject treated by Dr. Glazebrook and Mr. Rayner could hardly be over-estimated. He suggested that the experiments might be carried further with a view to elucidating other points of interest. Mr. Berry found so much that was beautiful in the paper that he had had to make a search for the merely useful. He noted that Mr. Rayner recognised the limits of laboratory tests, and he would point out that while the work had been done extremely well some of the tables might prove utterly misleading if not read with very great discretion. Mr. Rayner, in his reply, insisted upon the fact that as far as possible the tests had been carried out under ordinary commercial conditions. There is a tendency one knows to make light of laboratory experiments. This is a mistaken attitude. They have a very definite value and if correctly appraised are an admirable guide to the solution of problems which arise in commercial working. And while Mr. Rayner's tests come within the category of laboratory experiments, they approximate far more closely than is usually the case to the conditions met with in practice. The experiments themselves are referred to, and the results tabulated, in another part of this issue.

LONDON ELECTRIC POWER BILL.

THE most important of the nine electric power bills proposing to supply electricity in the London district is that of the Administrative County of London and District Electric Power Company, some particulars of which have already appeared in PAGE'S WEEKLY. Briefly, the object of the promoters is to establish three generating stations on the banks of the Thames and to supply electrical energy to all the existing electric supply companies and local authorities, and to other persons requiring supply for power purposes. At the present time there are within the proposed working area of the Administrative County of London Company thirty local authorities and twenty-one companies supplying energy from sixty-two generating stations, and it is argued on behalf of the bill that by concentrating the plant in large stations the price of energy can be so reduced that large manufacturers will find it to their advantage to make use of it. It is pointed out that in the industrial area of the new company there is manufacturing machinery amounting to 450,000 h.p., of which only about 4 per cent. is supplied by existing authorities. The present generating stations have been designed, it is said, for the main purpose of carrying on a lighting business, and in fact the lighting business of the present authorities is put down at 90 per cent. of the total. The part of the bill on which attention has been focussed is that relating to prices to be charged. The maximum is not to exceed 1½d. per unit, and the moderate consumer of current for power purposes would, it is claimed, be supplied at about 0·865d. per unit, a rate which no London Company has ever offered in an industrial area before.

The existing companies are naturally opposed to this scheme, and it is alleged that the proposed competition is manifestly unfair. These companies have played the part of pioneers in London, with the result that the dividends received by shareholders average no more than 4 per cent., and they naturally resent a new concern stepping in when the outlook is improving to reap the financial benefit of their past efforts. If the promoters of the new scheme succeed in their object it is held that it would mean the creation of a huge trust with a monopoly of the electrical supply for London in its hands, a condition of affairs which would not be to the ultimate benefit of the consumer. Broadly speaking, the existing companies say that if Parliament is prepared to give the sort of powers asked for, they should be given to the existing companies. On the subject of the multiplicity of stations, it may be pointed out that the present companies are debarred by the terms of their provisional orders from intercommunicating their stations, and thus cannot enjoy the benefits of concentration. The result is that each supply company and local authority has to keep its own stock of spare plant instead of being able to keep "spares" for the whole of London, as would be the case if the generating stations were interconnected. Why a system of interconnection should be outside their powers it is a little difficult to conjecture, but possibly the fear that jointly interested companies might become too powerful led to this proviso being insisted upon, as it is obviously easier for the local authorities to deal with separate undertakings rather than with companies which by intercommunication of mains have to a certain extent common interests to defend. As a matter of fact, a policy of concentration is already in process and is claimed to have produced remarkable reductions in the cost of supply.

In the all important question of price, it is argued that the basis on which the new company is fixing its maximum price, is to a certain extent fallacious, being surrounded by reservations calculated to make it ineffective. The question of local conditions has also been raised, and doubts expressed if current could be supplied at a profit in London on the same terms as in the Newcastle district. In this connection there are several considerations which are at once suggested. On the subject of the allegation that the existing companies have not encouraged power customers, it may be mentioned that one existing company alone is supplying something in the neighbourhood of 20,000 h.p., and supplying that power for all sorts of industrial purposes. It is probably true that the actual cost of generating this power is some fraction of a penny, but to that has to be added interest on capital, depreciation of plant, and other items which make it impossible to supply the current to consumers at the minimum price suggested in the new company's bill. The system in vogue by existing companies is to charge a certain maximum price for power, and to give a progressive discount according to the number of hours used. It is recognised, indeed, that the power business is likely to prove one of the best assets of the existing companies, and if this new company were allowed to come into operation, and secure power customers in the existing areas, it would probably mean that the prices for lighting would have to be raised, as the demand for power is mainly at low lighting load. The existing companies are, it is asserted, supplying current for power at very cheap rates.

With reference to the advantages of stations of large capacity, some of the existing stations run up to 20,000 to 30,000 h.p., and it is a moot question whether that power does not realise all the economy to be obtained by a policy of concentration. This applies particularly in the London district.

It is suggested that a preferable scheme to that now proposed would be for the County Council, local authorities, and the existing companies to promote a bill asking for powers to interconnect the whole of their stations, which should give all the advantages claimed for the new scheme.

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts.

CONTRACTS OPEN.

Last Day.

Newport (Mon.).—Construction of main outfall and branch sewers for the Western Valleys Sewerage Board. Particulars at offices of Mr. Baldwin-Latham, Parliament Mansions, Victoria Street, S.W.; Mr. Geo. Chatterton, 6, The Sanctuary, Westminster, S.W.; or Mr. T. S. Edwards, Clerk to the Board, Newport (Mon.) .. April 1

Rishworth (Yorks.)—Construction of a concrete service tank (56,000 gallons), on Rishworth Moor, including wood and slate roof, for the Rishworth Urban District Council Waterworks. Messrs. Richard Horsfall and Son, surveyors and architects, 22a, Commercial Street, Halifax April 1

Aberdeen.—Erection of new bridge of steel girders and masonry, for the Alford and Huntley District Committee. Mr. James Barron, Central Chambers, 216, Union-street, Aberdeen. ... ... April 3

Birmingham.—Supply, delivery, and erection of 200 electric tramway cars for the Tramways Committee. Mr. Alfred Baker, general manager, 254A, Corporation Street, Birmingham ... ... April 4

Rochdale.—Supply and delivery at their gasworks of two Lancashire steam boilers 30 ft. long by 8 ft. diameter, to work at a pressure of 150 lb. per square inch, for the Gas and Electricity Committee. Mr. T. Banbury Ball, Gasworks, Rochdale ... April 5

Olton and Bordesley.—Widening of a portion of the line between Olton and Bordesley, about 2¼ miles in length, for the Great Western Railway Company. Engineer, Paddington Station ... ... April 11

Bantry (Ireland).—Execution of works for carrying out the scheme for providing an additional supply of water for the town of Bantry, for the Rural District Council, according to plans and specification deposited for inspection in the Board room of the Council. Mr. Richard Croly, clerk, Board Room, Bantry ... ... April 11

Batley.—The following works in connection with the extension of the tramways in Bradford Road, for the Corporation: (Contract No. 14) permanent-way construction and paving; (15) overhead equipment, steel poles, etc.; (16) feeder cables, conduits, and accessories. Messrs. Lacey Sillar and Leigh, 2, Queen Anne's Gate, Westminster, S.W. ... ... April 17

Glasgow.—Electric power generating and lighting plant for Clydebank Dock, for the Trustees of the Clyde Navigation. Mr. T. R. Mackenzie, general manager and secretary, 16, Robertson Street, Glasgow, or from Mr. Geo. H. Baxter, mechanical engineer ... ... April 17

Last Day.

New South Wales.—Tenders will be received at the office of the Secretary for Public Works, Sydney, Australia, up to 2 o'clock p.m. on Friday, September 1st, 1905, for the manufacture, supply and delivery in the State of New South Wales of all iron and steel required by the Government. Full particulars may be obtained from the Agent-General's office, 9, Victoria Street, London, S.W. ... Sep. 1.

Aberdeen.—Supply of one surface condenser, with air pump, oil separator, etc., for the Electricity Department. Mr. J. Alex. Bell, city electrical engineer, Corporation Electricity Works, Millburn Street, Aberdeen ... ... April 19

Merthyr Tydfil.—Construction of certain waterworks, consisting of an aqueduct from the existing Neuadd resorvoirs in the Taff Fechan Valley, and extending for a distance of about 16 miles towards the southern boundary of the district, for the Merthyr Tydfil Urban District Council. Mr. Geo. F. Deacon, 15, Great George Street, Westminster, S.W. ... ... April 19

Manchester.—Construction of a new curve and the widening of a portion of their main line at Throstle Nest, Manchester, for the Cheshire Lines Committee. Mr. Harry Blundell, engineer to Cheshire Lines Committee, Central Station Liverpool ... ... April 27

Bishop's Stortford.—Carrying out of the following works at their sewage pumping station, for the Bishop's Stortford Urban District Council: (Contract No. 1) For supplying and fixing two Lancashire boilers, 18 ft. long by 6 ft. 6 in. diameter; (2) for supplying and fixing steam pumping engine and pumps. Mr. Thos. Swathebridge, 7, North Street, Bishop's Stortford ... ... May 8

COMING CONTRACTS.

Burnley.—The Electricity Committee has decided to purchase more plant, which will comprise a 500 k.w. generator, boiler and condensing plant.

Barnsley.—A loan of £4,403, for extensions at the electric lighting works has been applied for by the T.C.

London County Council.—At the last meeting, the Council approved an expenditure of £50,000 in connection with the purchase of the undertaking of the Woolwich and South-East London Tramways Co.

Ackworth.—An inquiry has been held by the Light Railway Commissioners into the Ackworth and North Lindsey light railway scheme. The total mileage proposed is 53, and the cost is estimated at £580,000.

Wantage.—The Council have adopted a report recommending the construction of new sewage works on a site where sufficient fall could be obtained to permit the construction of a percolating filter or double-contact beds.

Holyhead.—The construction of a landing-pier for passengers in the new harbour is deferred, pending the settlement of financial questions which have arisen.

Fleetwood.—A start has been made with the sewage scheme, which is estimated to cost £60,000.

Western Valleys Sewerage Board.—The Board is issuing a loan of £250,000 for new works.

Warwick.—An inquiry has been held into an application by the Town Council for leave to borrow £11,500 for waterworks.

Wisbech.—An application for sanction to borrow £25,000 for electric lighting purposes is under consideration.

CONTRACTS CLOSED.

Glasgow.—The Steel Company of Scotland, Ltd., has placed a contract with Mr. P. J. Mitchell, of London, for a complete installation of Rateau patent exhaust accumulator regenerators, together with necessary turbo-generating plant, condensers, cooling tower, etc. The plant will eventually, when the second unit is installed, provide the works with 1,300 e.h.p., without any increase on the present fuel costs.

Aberdeen.—The Lighting Committee has recommended that the tender of Bruce Peebles and Co. be accepted for a 420 k.w. generator.

Stockport.—The Tramways Committee have accepted the tender of Messrs. J. and W. S. Briscoe, Longshut-lane, Stockport, amounting to £10,326 12s. 5d., for the construction of the roadway in connection with the Hazel-grove tramways.

Manchester.—John Collier and Co., of Manchester, have recently secured an order from the Manchester Ship Canal Company for switchboards, feeders (over 20 miles lead and paper-covered cables in earthenware ducts) for power and lighting, required at their new dock in course of construction.

Admiralty.—Sir W. G. Armstrong, Whitworth and Company, Ltd., have recently secured the Admiralty contract for the supply of all high-speed steel required in the home and colonial dockyards during the next three years.

India.—The contract for a new bridge over the river Indus, at Khushalgarh, has been placed by the Secretary of State for India with the Tees Side Bridge and Engineering Works, Ltd., of Middlesbrough and London. The bridge, which has a double deck, carrying the railway on the top and a roadway below, consists of a cantilever span of 471 ft.—the slung portion being 261 ft. 8 in.—and an anchor span of 303 ft.

Battersea.—The Borough Council have accepted the tender of Babcock and Wilcox, Ltd., in connection with the extension plant now being provided at the central electric generating station, at £1,810.

London.—The Chain Belt Engineering Company, Derby, has recently received an order for three complete sugar-conveying plants to be installed at a large sugar refinery in the East End of London.

Swansea.—The Swansea Harbour Trust have ordered three 14-in. locomotives from Andrew Barclay, Sons and Co., Ltd., of Kilmarnock.

Pittsburg.—The Kennicott Water Softener Company informs us that it has just sold to the Carnegie Steel Company, Pittsburg, Penn., the largest continuous water softener that has ever been erected, viz., of a capacity of 150,000 gallons per hour. This machine will be 60 ft. high and 50 ft. in diameter, and the water to be treated is not only quite hard, but is full of free sulphuric acid, caused by the sludge of the coke ovens and rolling mills being drained into the river at that point.

APPOINTMENTS VACANT.

	Last Day.
London County Council.—Two divisional inspectors (at £600 per annum, rising by annual increments of £25 to £800), one possessing special qualifications in mathematics and science and the second in technology, including electrical and mechanical engineering; also an inspector in wood and metal work at £400, rising to £500...	April 1
India Office.—The Secretary of State for India is now prepared to receive applications for about thirty-five appointments of civil engineers for temporary service in India. Particulars from the Secretary, Judicial and Public Department, India Office, Whitehall, S.W.	—
Ipswich. — The Ipswich Dock Commissioners are about to appoint a harbour and dock master. Salary, £275, and a house with office and clerk. Particulars from Mr. Henry C. Casley, clerk, Ipswich.	April 8

APPOINTMENTS FILLED.

Rotherham.—Mr. Edward Cross has been appointed borough electrical engineer and general tramways manager at a salary of £350.

Salford.—The Salford Tramways Committee have appointed Mr. Geo. W. Holford, manager of the Corporation tramways, in succession to Mr. E. Hatton, who is leaving for Newcastle-on-Tyne.

Croydon.—Mr. D. A. Mason has been appointed superintendent of the Electricity Works.

Denbigh.—The Denbigh County Council has appointed Mr. Walter Douglas Wiles, who has been attached to the city engineer's office, Norwich, for the last eight years, as county architect and surveyor at a salary of £650 a year.

G.W.R.—Mr. Alfred Baldwin has been elected Chairman of the Great Western Railway, in succession to Earl Cawdor, who has had to resign owing to his appointment as First Lord of the Admiralty, in place of Lord Selborne. Mr. Baldwin is the son of Mr. George Baldwin, ironfounder, of Stourport, and Chairman of the well-known firm of Baldwins, Ltd.

Newport.—The Works and General Purposes Committee of the Newport Corporation recommend the appointment of Mr. A. G. Dovey, now in the engineer's department of the Corporation, as deputy borough engineer.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

The following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares business is being currently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our Share List will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from possible inaccuracies.

STOCK EXCHANGE SETTLING DAYS.—Settling days on the Stock Exchange are as follows:—

Consols: April 5th. General Settlements: April 18th, 28th, May 12th. Bank Rate, March 9th, 1905, 2½ per cent.

I.—ENGINEERING, IRON, AND STEEL COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
11,270	5	5%	Alldays & Onions Pneumatic Engineering, Ltd.	3	2⅞ — 3⅛
10,000	5	3/-	Do. Cum. Pref. 6 per cent. ..	5	4½ — 5
3,210,000	1	2/6	Armstrong (Sir W. G.), Whitworth and Co., Ltd.	1	3 5/16 — 3 7/16
76,970	5	2/-	Do. 4% Cum. Pref.. ..	5	5⅜ — 5⅝
1,500,000	100	4%	Do. 4% 1st Mort. Dbs. Rd.	100	102 — 104
£100,000	100	4½%	Aveling and Porter, Ltd., 4½% Reg. Mt. Debs. Red.	100	96 — 99
530,000	1	1/7½	Babcock and Wilcox, Ltd., Ord. ..	1	4⅜ — 4⅝
100,000	1	7½d.	Do. ,, 6% Cum. Pref.	1	1⅛ — 1⅜
20,000	5	3/-	Baker (Joseph) and Sons, Ltd., 6% Cum. Pref.	5	5 — 5½
250,000	1	6⅝d.	Baldwins, Ltd., 5½% Cum. Pref. ..	1	1 — 1⅛
£250,000	Stk	4½%	Do. 1st Mt. 4½% Deb. Stk. Red.	100	101 — 103
150,000	4½	2/8¾	Barrow Hæmatite Steel Co., Ld., O.	4½	1⅜ — 1⅝
50,000	4½	6/-	Do. do. Cum 2nd. Pref.	4½	4⅜ — 4⅝
33,334	5	2/6	Bayliss, Jones and Bayliss, Ltd., 5% Cum. Pref. Shares	5	4¾ — 5¼
£500,000	100	—	Beardmore (Wm.) & Co., Ltd., 4½% 1st Mt. Debs., Red., Scrip 50% pd	—	103 — 105
50,000	10	6/-	Bell Brothers, Ltd., 6% Cum. Pref.	10	11¾ — 12¼
£366,600	Stk	4%	Do 4% Deb. Stock, Red.	100	99 — 101
200,000	1	1/-	Beyer, Peacock and Co., Ltd., Ord.	1	⅝ — 11/16
300,000	1	6⅝d.	Do. 5½% Cum Pref.	1	⅞ — 1
£300,000	Stk	4½%	Do. 4½% Red. Deb. Stock	100	96 — 99
1,629,760	1	6d.	Bolckow, Vaughan and Co., Ltd., O. Nos. 1-1,629,760	1	1 — 1 1/16
1,860,900	1	3⅜d.	Do. Nos. 1,639,101-3,500,000	12/-	17/32 — 19/32
1,160,000	1	4½d.	Brown (John) and Co., Lim., Ord., Nos. 1-1,160,000	15/-	1⅛ — 1¼
590,000	1	6d.	Do. Ord., Nos. 1,160,001-1,750,000	1	1 13/32 — 1 17/32
74,000	10	5/-	Do. 5 % Cum. Pref.	10	11 — 11½
154,500	5	2/6	Cammell, Laird & Co., Ltd., Ord. ...	5	8¼ — 8¾
232,500	5	2/6	Do. 5% Cum. Pref. ..	5	5 5/16 — 5 7/16
450,000	1	1/6	Clayton & Shuttleworth, Ltd., Ord.	1	1 — 1 1/16
70,000	5	2/6	Do. 5% Cum. Pref.	5	5½ — 5¾
£250,000	Stk	4%	Do 4% 1st Mort. Db. Stk. Red	100	100 — 102
100,000	10	7/6	Consett Iron Co., Ltd., Ord.. ..	7½	32 — 33
57 031	10	10/-	Crossley, Bros., Ld, Ord. 40340/97370	10	16 — 16½
40,339	10	5%	Do. 5% Cum. Pref.	10	11⅝ — 11⅞
75,000	1	2/6	Delta Metal, Ltd. Shares	1	2 — 2¼*
1,259,594	1	3⅜d.	Dorman, Long & Co., Ltd.	1	⅝ — 11/16
£400,000	Stk	4%	Do. 4% 1st Mort. Perp. Deb. Stk.	100	91 — 94
200,000	5	3/-	Dunderland Iron Ore Co., Ltd., 6% Cum. Pref. and Participating..	5	3½ — 3¾
250,000	1	9⅜d.	Dunlop (James) & Co., Ltd., Ord...	1	9/16 — 11/16*
300,000	1	7½d.	Do. 6% Cum. Pref. ..	1	15/16 — 1
4,721	13	13/-	Ebbw Vale Steel, Iron & Coal Co., Ltd.	13	9½ — 10½
69,754	13	12/-	Do. do. do.	10	7½ — 8
20,250	10	3/-	Elliott's Metal, Ltd.	3	4¾ — 5¼
5,000	10	5%	Do. Cum. Pref. 5%	10	8¾ — 9¼
186,748	Stk	4%	Do. Deb. 4%	100	94½ — 96½
25,000	10	6/-	Fairfield Shipbuilding & Engng. Co., Ltd., 6% Cum. Pref. ..	10	10½ — 11½
£250,000	Stk	4½%	Do. 4½% Mort. Deb. Stk. Red.	100	100 — 103
9,000	10	10%	Fleming & Ferguson, Ltd. Ord. Nos. 1/9000..	10	12½ — 12¾
6,000	10	5%	Do. 5% Cum. Pref. Nos. 9001/15000	10	9½ — 10
126,000	3	3/-	Fraser & Chalmers, Ltd., Ord. ..	3	4⅛ — 4⅞
21,000	3	1/6	Do. 7½% Cum. Pref.	3	5¾ — 6¼
10,000	10	5%	Galloways, Ltd., 5% Cum. Pref. 18001/28000	10	6 — 7
£150,000	Stk	4%	Do. 4% 1st Mort Deb Red..	100	90½ — 91½
16,800	10	—	Greenwood & Batley, Ltd., Ord. ..	10	4¼ — 4¾
9,600	10	7%	Do. 7% Cum. Pref.	10	10¼ — 10¾
965,000	1	1/-	Guest, Keen & Nettlefolds, Ltd. Ord.	1	2⅜ — 2⅝
344,000	5	2/6	Do. 5% Cum. Pref.	5	5⅞ — 6⅛
£1,350,500	Stk	4%	Do. 4% Irred. Mort. Deb. Stk	100	107 — 109
13,000	5	2/6	Gwynnes, Ltd., 5% Cum. Pref. ..	5	2 — 3
250,000	1	3/6	Hadfield's Steel F'dry Co., Ld., Ord.	1	3 — 3⅛
20,000	10	4/6	Do. 4½% Cum. Pref.	10	10¾ — 11¼
30,000	5	3/-	Hall (J. & E.), Ltd. 6% Cum. Pref...	5	5 — 5½
408,505	1	1/6	Harvey United Steel Co., Ltd. ..	1	1¼ — 1⅜*
47,500	10	7½%	Hawthorn. Leslie & Co., Ltd. Ord.	10	10¾ — 11
28,001	5	7/-	Head, Wrightson & Co., Ltd. ..	5	5 — 5½
85,000	1	7½d.	Hill (Richard) & Co. (1899) Ld., Ord.	1	¾ — ⅞
18,000	5	3/-	Do. 6% Cum. Pref.	5	4½ — 5
30,000	10	6/-	Hornsby (Richard) & Sons, Ld., Ord.	8	5½ — 6

ENGINEERING, IRON, AND STEEL COMPANIES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
750,000	1	6d.	Howard & Bullough, Ltd., Ord. ..	1	1⅝ — 1¾
25,000	10	6/-	Do. 6% Pref. (Non-Cum.) ..	10	13 — 13½
£250,000	Stk	4%	Do. 4% Deb. Stk., Red. after 1905	100	98 — 101
37,500	10	20	Kynoch, Ltd.	10	18¾ — 19¼
49,537	10	5%	Do. Cum. Pref. 5%	10	10¾ — 11
300,000	1	4½d.	Lambert Bros., Ltd., Ord.	1	⅝ — ⅞
50,000	5	2/9	Do. 5½% Cum. Pref.	5	4 — 4½
40,000	3	2/1½	Leeds Forge Co, 7% Cum. Pref. ..	3	3¾ — 4¼*
200,000	1	7½d.	Lysaght (John), Ltd., 6% Cum. Pf.	1	1 1/16 — 1 3/16
£300,000	Stk	4½%	Do 4½% 1st Mt. Deb. Stk., Red.	100	108 — 110
40,000	10	5/-	Mather & Platt, Ld., 5% Cum. Pref	10	11 — 11½
210,000	1	8½d.	Measures Bros., Ltd., Ord.	1	9/16 — 11/16
75,000	1	6⅝d.	Do. 5½% Cum. Pref.	1	⅞ — 1
£75,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	94 — 97
21,943	5	2/6	Muntz Metal, Ltd.	5	5⅛ — 5⅝
14,248	5	5%	Do. Pref. 5%	5	5 — 5½
5,000	62½	47/6	Nantyglo and Blaina Iron Works, Ltd., 8% Cum. Pref.	62½	76 — 80
73,000	10	5/-	N. Brit. Loco. Co., Ltd., 5% Cm. Pf.	10	12 — 12½*
80,000	5	—	North-Eastern Steel Co., Ltd., Ord.	5	—
£250,000	Stk	4½%	Do. 4½% 1st Mrt. Db. Stk., Red.	100	90 — 93
122,000	5	2/-	Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B"	5	4 — 4½
50,000	5	3/-	Do. 6% Cum. Pref. "A" ..	5	6 — 6½
70,000	10	6/-	Pease & Partners, Ltd., Ord. ..	10	10¼ — 10¾
£400,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	98 — 101
20,000	5	3/-	Peebles (Bruce) & Co., Ld., 6% Cm. P.	5	4⅞ — 5⅛
65,000	1	—	Pooley (Henry) & Son., Ltd., Ord ..	1	6/- — 6/6
13,000	5	—	Do. 5½% Cum. Pref.	5	4 — 4½
230,000	1	—	Projectile Co. (1902), Ltd., Ord. ..	1	⅛ — ⅜
126,938	5	2/-	Rhymney Iron Co., Ltd.	5	1¾ — 2
78,062	5	2/-	Do. New	5	1½ — 1¾
£330,000	—	5%	Do. 5% Mort. Deb., Red. ..	100	101 — 103
350,000	1	7½d.	Richardsons, Westgarth & Co., Ltd., 6% Cum. Pf. ..	1	⅞ — 15/16
£350,000	Stk	4½%	Do. 4½% Perp. Deb. Stock ..	100	94 — 96
35,000	10	12/-	Ruston, Proctor & Co., Ltd... ..	10	9½ — 10
275,000	1	6d.	Scott (Walter), Ltd., Ord.	1	13/16 — 15/16
300,000	1	7½d.	Do. 6% Cum. Pref. ..	1	1 — 1⅛
£300,000	Stk	4%	Do. 4% Perp. Deb. Stk.	100	94 — 96
£115,800	100	5%	Shelton Iron, Steel and Coal Co., Ld. 1st Charge 5% Debs.. Red ..	100	92 — 95
£97,900	100	6%	Do. 6% 2nd Mort. Debs., Red.	100	91 — 95
250,000	1	1/-	South Durham Steel & Iron, Ltd. Or.	1	⅝ — 11/16
300,000	1	1/2¾	Do. 6% Cum. Pref...	1	27/32 — 29/32*
£300,000	Stk	4½%	Do. 4½% Per. Deb. Stock	100	89 — 92
49,560	10	2½%	Steel Co. of Scotland Ord. 1/49560..	9	5½ — 5⅝
£125,240	Stk.	5%	Do. 5% Trust Mort. Deb. ..	100	106½ — 107½
25,000	10	—	Stephenson (Robert) & Co., Ltd., Or.	10	2¼ — 2¾
25,000	10	5/6	Do. 5½% Cum. Pref. ..	10	4¼ — 4¾
£250,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	79 — 82
85,000	10	9/-	Stewarts & Lloyds, Ltd., Ord. ..	10	17½ — 18
55,000	10	6/-	Do. 6% Cum. Pref.	10	14½ — 15½
634,782	1	6d.	Swan, Hunter & Wigham-Richardson, Lim. Ord.	1	⅝ — ⅞*
538,845	1	6d.	Do. 5% Cum. Pref.	1	⅞ — 1*
£240,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Red	100	98 — 101
300,000	1	6d.	Thames Iron Works, Shipbuilding & Engineering Co., Ltd., 5% Cum. Pf.	1	½ — 9/16
£200,000	100	4%.	Do. 4% Irredeem. 1st Mort. Deb.	100	67 — 71
£160,000	1	7½d.	Thornycroft (John I.) & Co., Ltd. 6% Cum. Pref.	1	15/16 — 1 1/16
10,000	10	5/-	Tylor (J.) & Sons, Ltd. 5% Cum. Pf.	10	9½ — 10
$508495200	$100	$½	United States Steel Corp. Com. Stk.	$100	35⅜ — 35¾
$360314100	$100	$1¾	Do. 7% Cum. Pref. Stock	$100	97 — 97½
$162268000	$1000	5%	Do. 10-60yr. 5% Skg. Fd. G. Bds.	$1000	97 — 99
3,350,000	1	1/6	Vickers, Sons & Maxim, Ltd. Ord..	1	2 7/16 — 2 9/16*
750,000	1	6d.	Do. 5% Non-Cum. Pref. ..	1	1 3/16 — 1 5/16*
£750,000	Stk	5%	Do. 5% Non-Cum. Pref. Stock.	100	117 — 120*
£1,250,000	Stk	4%	Do. 4% 1st. Mort. Deb. Stk. Red.	100	106 — 108
£1,000,000	100	4½%	Do. 4½% 2nd Mort. Debs., Red.	100	106 — 108
225,000	1	1/2⅜	Weardale Steel, Coal & Coke, Ltd., Def. Ord.	1	⅝ — ⅞
500,000	1	7½d.	Do. 6% Cum. Pref. Ord. ..	1	⅞ — 1
£300,000	Stk	4%	Do. 4% Perpetual Deb. Stock	100	85 — 89
7,637	5	2/9	Weldless Steel Tube, Ltd., Cum. Pref. 5½	5	4⅜ — 4⅞
800	Stk	4½%	Do. Mort. Deb. 4½%	100	91 — 97
66,666	5	3/.	Willans & Robinson, Ord.	5	1 — 2
66,666	5	3/-	Do. 6% Cum. Pref.	5	3 — 4
£246,641	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red	100	75 — 80
£150,000	Stk	4½%	Yorkshire Iron & Coal Co., Ltd., 4½% 1st Mort. Deb. Stk. Red.	100	81 — 86

Stocks and Shares marked * are quoted ex-dividend.

II.—ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name	Paid up.	Closing Prices.
70,000	1	6d.	Alliance Elec. Co., Ltd. 5% Cum. Pf.	1	⅝— ⅞
125,000	1	7½d.	Aron Elec. Meter Ltd., 6% Cum. Pf.	1	7/16— 9/16
120,000	1	9½d.	Bell's Asbestos Co., Ltd.	1	¾— ⅞
100,000	5	4/-	British Insulated & Helsby Cables Ltd., Ord. ..	5	5¾— 6¼
100,000	5	8/-	Do. 6% Cum. Pref.	5	5½—5¾
£500,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Rd.	100	101 —104
£200,000	Stk	4½%	British Thomson-Houston Co., Ltd., 4½% 1st Mort. Deb. Stk. Red. ..	100	99 —101
400,000	5	8/-	British Westinghouse Electric and Manufac. Co., Ltd., 8% Pref. ..	5	8 — 8½
£516,358	Stk	4%	Do. 4% Mort. Deb. Stk. Red...	100	91 — 93
105,731	2	2/-	Brush Elec. Enging. Co., Ltd., Ord. ..	2	½— ¾
150,000	2	2/4½	Do. 6% Pref.	2	1⅛— 1⅜
£125,000	Stk	4½%	Do. 4½% Perp. 1st Deb. Stk...	100	92 — 95
£125,000	Stk	4½%	Do. 4½% Perp. 2nd Deb. Stk.	100	79 — 82
35,000	5	5/-	Callender's Cable & Constn. Ltd. Ord.	5	11 — 11½
40,000	5	2/6	Do. 5 % Cum. Pref.	5	5⅛— 5⅜
£200,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Red.	100	106 —108
85,000	3	1/6	Crompton & Co., Ltd...	3	2⅛— 2⅜
£100,000	—	5%	Do. 5% 1st Mort. Reg. Debs.	100	98— 98
52,000	5	10/-	Dick, Kerr & Co., Ltd., Ord. ..	5	8 — 8½
61,000	5	8/-	Do. 6% Cum. Pref.	5	5⅞— 6⅛
£300 000	Stk	4½%	Do. 4½% Deb. Stock, Red. ..	100	105 —107
233,334	1	6d.	Doulton & Co., Ltd., 5% Cum. Pref.	1	1⅛— 1⅜
£233,334	Stk	4%	Do. 1st Mort. 4% Iree. Deb. Stk.	100	106 —109
99,261	5	1/6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	3	1 — 1¼
17,139	5	2/6	Do. "A" Shares Nos. 01-017,139	5	1¾— 2¼
£344,023	Stk	4%	Do. 4% Deb. Stock Red. ..	100	80 — 85
£100,000	Stk	5%	Do. 5% Second Deb. Stk. Red.	100	86 — 91
112,100	2	1/7½	Electric Construction Co., Ltd. ..	2	1⅛— 1⅜
31,390	2	2/9¾	Do. 7% Cumulative Pref. ..	2	2¼— 2½
£200,000	Stk	4%	Do. 4% Perp. 1st Mt. Deb. Stk.	100	97 — 99
10,248	10	7/6	Evered and Co., Ltd...	10	12 — 14
£100,000	Stk	5%	Ferranti, Ltd., 5% 1st Mort. Deb. Stock, Red...	100	90 — 95
25,000	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9½— 10
£200,000	Stk	4%	Do. 4% 1st. Mt. Deb. Stk., Red.	100	91 — 96
35,000	5	10/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	12½—13*
35,000	5	2/3	Do. 4½% Cum. Pref... ..	5	5⅜— 5⅝
£50 000	Stk	4½%	Do. 4½% Mt. Deb. Stk. Red.	100	109—111
50,000	10	5/-	India Rubber, Gutta Percha & Telegraph Works Co., Ltd.,	10	16 — 17
£300,000	100	4%	Do. 1st Mort. Deb. Red. ..	100	100 —103
7,500	10	—	Parker, Thos., Ltd.	10	6½— 7*
100,000	1	8%	Scott (Ernest) & Mountain, Ld., Ord.	1	16/—17/-
37,350	12	24/-	Telegraph Construction and Maintenance Co., Ltd.	12	36 — 38*
£150,000	100	4%	Do. 4% Deb. Bonds	100	103 —105

III.—ELECTRIC TRACTION.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
120,000	5	8/-	Anglo-Argentine Trams Co., Ld., Or.	5	8⅜— 8⅝
260,007	5	2/6	Do. 5% Cum Pf.	5	5⅜— 5⅝
£230,000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888 ..	100	140 —143
20,000	10	6/-	Barcelona Trams Co., Ltd., Ord. ..	10	12 — 12½
10,000	10	5/-	Do. 5% Cum Pf. Shares	10	9 -- 10
£46,300	100	5%	Do. 5% Debs., Red. ..	100	99 --102
£191,326	Stk	4½%	Do. 4½% Red. Deb. Stk.	100	96 —100
75,606	1	—	Bath Elec. Trams. Ld., Pf. Or. ..	1	13/16— 15/16
59,894	1	11·40d	Do. 5% Cum. Pf. ..	1	15/16— 1 1/16
75,000	5	—	Brisbane Electric Tram Investment Co., Ltd., Ord... ..	5	1 — 1¼
75,000	5	2/6	Do. 5% Cum. Pf. ..	5	3¾— 4¼
£425,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	94 — 98
£200,000	Stk	6%	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	103 —106
		%	Pref. Ord. Stock	100	100 —103
133,301	10	6/-	Brit. Electric Traction, Ltd., Ord.	10	9¼— 9¾
156,487	10	6/-	Do. 6% Cum. Pref... ..	10	10⅝—11⅛
£1,000,000	Stk	5%	Do. 5% Perp. Deb. Stk. ..	100	122 ·124
£250,000	Stk	4½%	Do. 4% 2nd Deb. Stk. Red..	100	98 —100
100,000	5	1/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	3¾— 4
40,500	5	3/-	Do. "A" 6% Cum Pref. ..	5	5⅜— 5⅞
57,000	5	3/-	Do. "B" do.	5	5⅜— 5⅞

ELECTRIC TRACTION.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£200,000	Stk	5%	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	95 — 98
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	103 —106
102,268	5	8/-	Calcutta Tramways Co., Ltd. ..	5	9⅜— 9
£350,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red.	100	106 —108
480,000	1	6d.	Cape Electric Tramways, Ltd. ..	1	1⅛— 1
40,000	5	2/6	City of Birmingham Trams Co., Ltd. 5 % Cum. Pref.	5	4⅜— 5
£300,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	101 —104
£120,000	Stk	5%	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	103 —105
60,000	10	6/-	Dublin United Trams. Co. (1896), Ltd., Ord. ..	10	13½— 14
59,987	10	6/-	Do. 6% Pref...	10	15½— 16
30,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	8 — 8½
£150,000	Stk	4%	Do. 4% Deb. Stock.. ..	100	89 — 9
125,000	10	5/-	London United Trams. (1901), Ltd., 5% Cum. Pref.	10	10 —10½
£1,081,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	99 —102
£50,000	Stk	5%	Madras Electric Trams (1904), Ltd., 5% Deb Stock, Red.	100	101 —103
314,016	1	—	Metropolitan Elec. Trams, Ltd., Def.	1	11/32—13/32
500,000	1	6d.	Do. 5% Cum. Pref... ..	1	1 — 1 1/16
£350,000	Stk	4½%	Do. 4½% Deb. Stock, Red.	100	105 —107
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	⅞— 1
110,928	8	8/2¾	North Metropolitan Tramways Co..	8	3¾— 4¼
£150,000	100	3½%	Do. 3½% Mort. Debs.	100	90 — 95
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red..	100	106 —108
24,500	10	10/-	Potteries Elec. Traction Co., Ld., Or.	10	9¾— 10
24,500	10	5/-	Do. 5% Cum. Pref. ..	10	9½— 10
£220,000	Stk	4½%	Do. 4½% Deb. Stk., Red.	100	103 —107

IV.—ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
7,500	10	16/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. ..	10	12½— 12
7,500	10	4/6	Do. 4½% Cum. Pref. ..	10	9½— 10
7,500	10	6/-	Do. 6% Cum. Second Pf. ..	10	11 — 12
£70,000	Stk	4½%	Do. 4½% Deb. Stock Red ..	100	105 —107
14,000	5	2/-	Bromley (Kent) Elec. Lt. & Pr. Co. Ld	5	5¼— 5
£50,000	Stk	4½%	Do. do. 4½% 1st Deb. Stk. Red.	100	103 —106
27,507	5	4/6	Brompton & Kensington Elec. Supply Co., Ltd. Ord. ..	5	10½— 10
12,493	5	8/6	Do. 7% Cum. Pref. Shares..	5	10 — 10
60,000	5	8/-	Calcutta Elec. Sup. Cor. Ltd., Ord..	5	9 — 9½
£288,782	Stk	4%	Central Elec. Sup. Co., Ltd., 4% Gua. Deb. Stk. ..	100	105 — 10
70,000	5	4/-	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord... ..	5	8 — 8½
80,000	5	2/3	Do. do. 4½% Cum. Pref...	5	5½— 5
£350,000	Stk	4%	Do. do. 4% Deb. Stk. Red.	100	105 —107
41,436	5	8/9	Chelsea Elec. Sply. Co., Ltd., Ord.	5	6¾— 7¼
£150,000	Stk	4½%	Do. do. 4½% Deb. Stk., Red	100	109 —111
70,595	10	7/-	City of London El. Lghtg. Co., Ld., O.	10	11¼— 11
40,000	10	6/-	Do. 6% Cum. Pref... ..	10	13¾— 14
£400,000	Stk	5%	Do. 5% Deb. Stk., Red ..	100	123 —127
£300,000	Stk	4½%	Do. 4½% 2nd Deb. Stk., Red	100	103 —105
40,000	10	4/-	County of London Elec. Supply Co., Ltd., Ord.	10	9½— 10
30,000	10	6/-	Do. 6% Cum. Pref.	10	12¼— 12
£400,000	Stk	4½%	Do. 4½% Deb. Stk., Red. ..	100	110 —113
70,000	5	2/6	Edmundson's Elec. Cor. Ltd., Ord.	5	6⅛— 6
70,000	5	3/-	Do. 6% Cum. Pref.	5	6⅛— 6
£300,000	Stk	4½%	Do. 4½% 1st Mort. Db. Stk. Reg	100	106 —108
£80,000	Stk	5%	Electric Lighting & Traction Co. of Australia, Ltd. 5% Deb. Stk. Red.	100	86 — 91
10,000	5	2/-	Folkestone Elec. Supply Co., Ld., O.	5	5½— 6
£50,000	Stk.	4½%	Do. 4½% 1st Deb. Stk., Red.	100	101 —104
15,000	10	—	Havana Electricity Co., Ltd... ..	10	9½—10½
13,000	5	8/6	Hove Elec. Lighting Co., Ltd., Ord.	5	7¾— 8¼
£50,000	Stk	4½%	Isle of Wight Electric Light & Power Co., Ltd. 4½% Deb. Stock, Red.	100	101—103
150,000	1	—	Kalgoorlie Electric Power & Lighting Corp, Ltd., 6% Cum. Pref.	1	⅜—
21,000	5	7/-	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord. ..	5	12½— 13

Stocks and Shares marked * are quoted ex-dividend.

ELECTRIC LIGHTING AND POWER.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£135,000	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	102 —104
111,000	8	1/9⅜	London Elec. Supply Corp., Ld., Ord.	8	2 9/16—2 13/16
60,000	5	3/-	Do. 6% Pref.	5	5¾ — 6
£371,895	Stk	4%	Do. 4% 1st Mort.Db.Stk., Red.	100	99 —101
100,000	10	11/-	Metropolitan Elec. Sup. Co., Ld., Or.	10	18 —18½*
76,121	5	2/3	Do. 4½% Cum. Pref.	5	5⅝ — 5¾
230,000	Stk	4½%	Do. 4½% 1st Mort.Db.Sk., Red.	100	110 —115
250,000	Stk	3½%	Do. 3½% Mort. Deb. Stk., Red.	100	97 — 99
£250,000	—	4½%	Midland Elec. Corp. for Power Distribution. Ld., 4½% 1st Mort.Deb.	100	99 —101
10,852	10	8/-	Notting Hill Elec. Ltg. Co. Ltd. Ord.	10	14½—15½*
£59,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	102 —104
16,500	5	4/6	Oxford Electric Co. Ltd., Ord. ..	5	6½— 6¾*
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	98 —100
£84,700	100	4½%	Royal Elec. Co. (of Montreal) 4½% 20-yr. 1st Mort. Deb	100	100 —102
40,000	5	9/6	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	13¾—14¼
20,000	5	3/6	Do. 7% Pref...	5	8¼— 8¾
£150,000	Stk	3½%	Do. 3½% Deben. Stock, Red	100	98 —100
12,000	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2⅞— 3⅛
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	79 — 83
65,000	5	4/-	South London Elec. Sup. Co., Ltd. O.	5	4 — 4½*
100,000	1	—	South Metropolitan Elec Light & Power Co., Ltd. Ord.	1	⅞ — 1
50,000	1	8⅖d.	Do. 7% Cum. Pref.	1	1 5/16—1 7/16
£100,000	Stk	4½%	Do. 4½% 1st Deb. Stock Red.	100	107 —110
50,000	5	2/6	Urban Electric Supply Co., Ltd., O.	5	5 1/16—5 3/16
30,000	5	2/6	Do. 5% Cum Pref.	5	5⅛— 5¼
£200,000	Stk	—	Do. 4½% 1st Mort.Deb.Stk.Red	100	106 —108
110,000	5	7/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	12½—13
28,151	5	2/6	Do. 5% Cum. Pref.	5	6¼— 6¾

V.—TELEGRAPH & TELEPHONE COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
£34,800	100	4%	African Direct Tel. Co., Ld., 4% Mt. Debs. (Series A), Red.	100	99 —102
25,000	10	—	Amazon Telegraph Co., Ld... ..	10	2¼ — 2¾
£763,580	Stk	17/6	Anglo-American Tel. Co., Ltd., Ord.	100	61 — 63
£3,118,210	Stk	35/-	Do. 6% Preferred Ordinary	100	108½—109½
£3,118,210	Stk	2/-	Do. Deferred Ordinary ..	100	16¼—16¾
44,000	5	3/-	Chili Telephone Co., Ltd.	5	6⅝— 6⅞
$15,000,000	$100	$2	Commercial Cable Co., Capital Stk.	$100	230 —240
£1,903,856	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	98 —100
16,000	10	5/-	Cuba Submarine Tel. Co., Ld., Ord.	10	8¾— 9¼
6,000	10	10/-	Do. 10% Preference	10	17 — 18
6,000	5	2/-	Direct Spanish Telegraph Co., Ord.	5	3⅜— 3⅝
		5/-	10% Cum. Preference	5	8½— 9
£30,000	50	4½%	Do. 4½% Debs...	50	101-103%
60,710	20	3/-	Direct U.S. Cable Co., Ltd... ..	20	11⅜—11⅝
£85,800	100	4½%	Direct West India Cable Co., Ltd., 4½% Reg. Debs.	100	100—102
£300,000	100	4%	East. & S. African, Ld., 4% Mt. Dbs.	100	100—102
£200,000	25	4%	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)..	25	101-103%
300,000	10	2/6	Eastern Extension, Australasia and China, Ltd...	10	14¼— 14¾
£602,400	Stk	4%	Do. 4% Mort. Deb. Stk., Perp.	100	105 —107
£4,000,000	Stk	25/-	Eastern Tele. Co., Ltd., Ord. ..	100	145 —148
£2,000,000	Stk	17/6	Do. 3 % Pref.	100	92 — 94
£1,836,814	Stk	4%	Do. 4% Mort. Deb.	100	107 —109
150,000	10	5/-	Great Northern Telegraph Co., Ltd., (of Copenhagen) ..	10	37 — 39
£58,700	100	4½%	Halifax and Bermudas Cable Co., Ltd., 4½% 1st. Mort. Debs. Red.	100	100—102
17,000	25	12/6	Indo-European Tele. Co., Ltd. ..	25	47 — 49
72,680	1	7½d.	Monte Video Telephone Co., Ltd., O.	1	13/16— 15/16
£1,983,333	Stk	6%	National Telephone Co., Ltd., Pref.	100	109½-110½*
£1,966,667	Stk	5%	Do. Deferred	100	103½-105½*
250,000	5	2/6	Do. 5% Non-Cum. 3rd Pref.	5	5⅜ — 5⅝*
£2,000,000	Stk	3½%	Do. 3½% Deb. Stk., Red. ..	100	100—102
£689,593	Stk	4%	Do. 4% do. do. ..	100	103½—105½
179,313	1	7½d.	Oriental Telephone & Elec. Co., Ltd.	1	1¼ — 1⅜
50,000	1	7⅕d.	Do. 6% Cum. Pref.	1	1 3/16 — 1 5/16
£100,000	100	4%	Pacific & European Tel. 4% Guar. Debs. Red...	100	98 —101
11,839	8	4/-	Reuter's Telegram Co., Ltd. ..	8	7¼— 7¾
53,000	5	3/-	United River Plate Telep. Co., Ltd.	5	7 — 7½
40,000	5	2/6	Do. 5% Cum. Pref.	5	5 — 5½
£179,947	Stk	5%	Do. 5% Deb. Stock, Red. ..	100	107—109
15,609	10	4/-	W. African Telegraph Co., Ltd. ..	10	8 — 8½
£30,008	2½	—	West Coast of America, Ltd. ..	2½	1/16 — 3/16
150,000	100	4%	Do. 4% Deb. Guar. by West. Tel.	100	100 — 102

TELEGRAPHS AND TELEPHONES.—*Contd.*

Present Amount Subscribed.	Shares.	Last Dividend.	Name	Paid up.	Closing Prices.
88,321	10	6d.	W.India&PanamaTeleg.Co., Ld., Or.	10	⅞— 1
34,563	10	6/-	Do. 6% Cum. 1st. Pref. ..	10	8½— 9
4,669	10	6/-	Do. 6% Cum. 2nd Pref. ..	10	8¼ 8¾
£80,000	100	5%	Do. 5% Deb.	100	103 —105
207,930	10	3/-	Western Telegraph Co., Ltd. ..	10	13¾— 14¼
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	101 —103
518,945	Stk	4%	Do. 4% Deb. Stock, Red. ..	100	103 —105

VI.—SHIPPING COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
32,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 5½% Cum. Pref.	10	8½— 9
£325,000	Stk	4½%	Do. 4½% Red. 1st Mort. Deb.Stk.	100	100—102
£672,900	Stk	4½%	British & African Stm. Nav. (1900) Ltd., 4½% 1st Mort. Deb. Stk.. Red.	100	94 — 96
40,000	10	5/6	Bucknall Steamship Lines, Ltd., 5½% Cum. Pref.	10	6 — 6½
£600,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk.	100	78 — 81
£750,000	Stk	4½%	Clan Line Steamers, Ltd., 4½% Deb. Stk. Red. ..	100	100 —102
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000..	20	13¾- 14¼
40,000	20	8/-	Do. Nos. 60,001-100,000	10	5¾— 6¼
£461,430	Stk	4½%	Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. ..	100	101 —103
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord...	1	1 5/16—1 7/16
25,328	7½	4/7	Gen. Steam Navigation Co., Ld., Ord.	7½	4½— 5
36,758	8	4/9⅗	Do. Non-Cum. 6% Pref... ..	8	7¾— 8¼
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	101—102
55,000	5	1/3	Houlder Line, Ltd., Ord.	5	2½— 3
40,000	5	2/9	Do. 5½% Cum. Pref.	5	3 — 3½
£200,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk. Red.	100	83 — 86
141,500	10	5/-	Leyland (Fredk.), & Co.. (1900), Ltd., 5% Cum. Pref. ..	10	5¼ 5¾
£1,160,000	Stk	5 %	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. ..	100	132 —135
£1,160,000	Stk	19%	Do. do. Deferred ..	100	228 —231
15,000	100	30/-	Royal Mail Steam Packet Co. Ord..	60	25½— 26½
39,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref..	5	4¾— 5¼
39,075	5	2/6	Do. "B" Ord...	5	4 — 4½
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord..	10	8¼— 8¾
24,000	10	4/6	Do. 4½% Cum. Pref... ..	10	10¼— 10¾
£1,008,894	Stk	4%	Do. 4% Debenture Stk., Red.	100	100 —102

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
60,000	1	9⅗d.	Chadburn's (Ship) Tele. Ltd., Ord...	1	1— 1⅛
£750,000	Stk	9%	General Hydraulic Power Co., Ltd.	100	180 —185*
12,500	10	10/-	Oakey (John) and Sons, Ltd., Ord..	10	24 — 26
10,000	10	6/-	Do. do. 6% Cum. Pf.	10	14 — 15
183,588	1	6·3d.	Power Gas Corp., Ltd., Ord., Nos. 66,463-250	15/-	5/16— 7/16
66,462	1	8·4d.	Do. do. Nos. 1 66,462	1	9/16— 11/16
135,000	1	6d.	Waygood (R.) & Co., Ltd., Ord. ..	1	1 1/16— 1 3/16
135,000	1	7⅕d.	Do. 6% Cum. Pref. ...	1	1⅛— 1¼

RAILWAY CARRIAGE & WAGON COMPANIES.

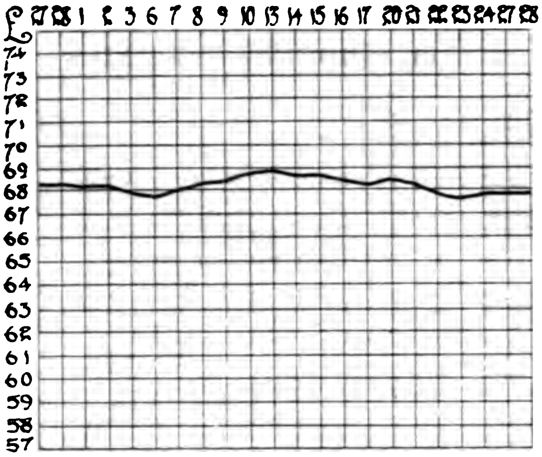
Present Amount Subscribed.	Shares.	Last Dividend.	Name.	Paid up.	Closing Prices.
10,000	10	7/6	Birm. Railway-Car. & Wagon, L., 1-10,000	10	21 —22
8,739	10	3/-	Do. Second Issue 1-8,739....	4	8¾— 9
10,000	10	6/-	Do. Cum. Pref. 6% 1-10,000..	10	13 —13½
30,111	7	7/-	Gloucester Rail.-Car & Wagon, Ld., A, 1-29,861 & 49,751-50,000	7	9 — 9½
44,889	7	3/6	Do. B, 29,862-49,750, 50,001-75,000	7	3⅞— 4⅛
14,567	10	1/3	Lancashire Wagon, Ord.	2	2 3/16—2 5/16
4,150	10	5%	Do. do.	10	10¼—10¾
781,808	1	9d.	Metropolitan Amalgamated Rail.-Carriage & Wagon, Ld., 1-784,808		41/—42/
164,288	1	6d.	Do. Cum. A Pref. 5% 1-164,288		23/6—24/6
235,000	1	7⅕d.	Do. Cum. B Pref. 6% 1-235,000		27/6—28/6
20,000	20	20/-	Midland Rail.-Car. & Wagon, Ld., 1-20,000	10	18¾—19¼

Stocks and Shares marked * are quoted ex-dividend.

THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM FEBRUARY 27TH TO MARCH 28TH, 1905.

COPPER.



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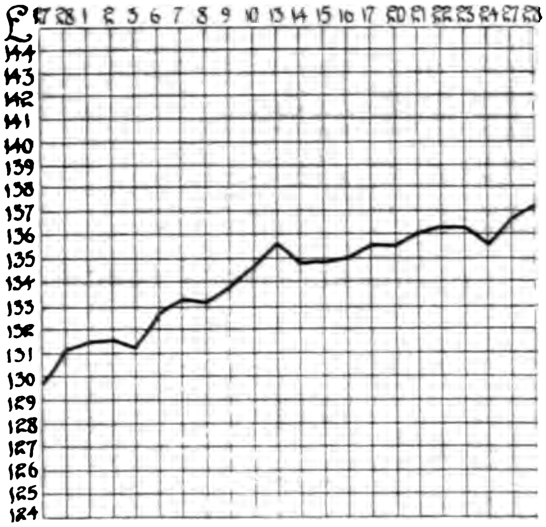

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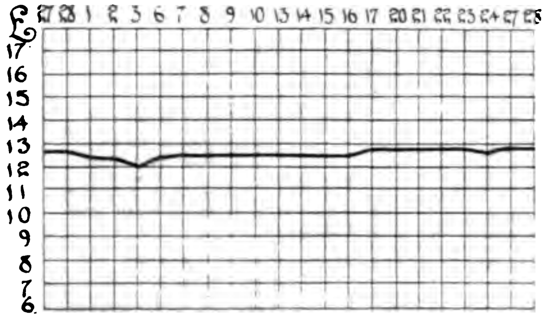
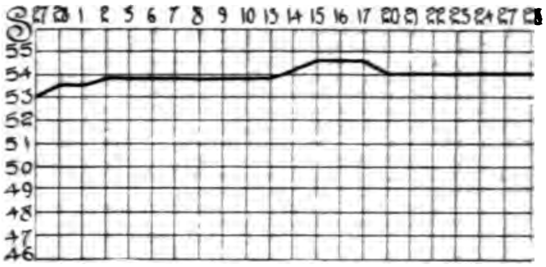


PIG IRON: SCOTCH,



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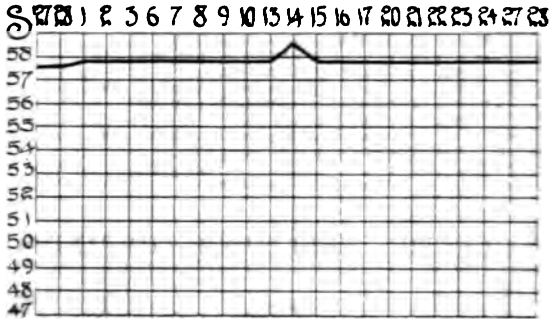
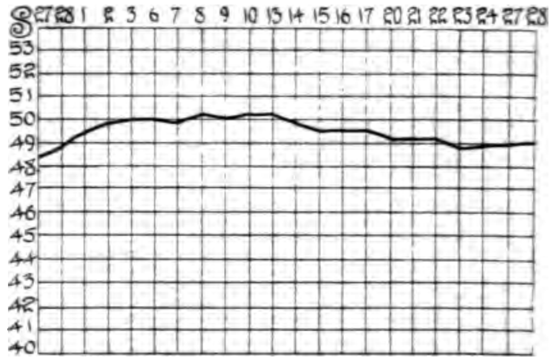
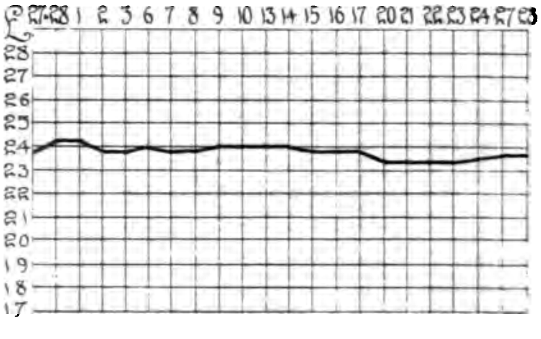


CLEVELAND.



SPELTER.



PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

MARKET REPORT.

Wednesday, March 29th, 1905.

THERE have been no fresh developments in the Copper market during the past week, the speculative spirit having temporarily subsided. At one time the bear party made a partially successful attempt to depress prices, and forward metal was sold down to £67 17s. 6d. At this level buyers came forward and put the price to over £68, and the market remains steady round about that figure. Quiet, without weakness, would, perhaps, best describe the position at the moment. The closing price to-day was £67 15s. cash, and £68 three months.

Tin has been a firm and active market, and as high as £137 10s. has been paid for spot metal. The outstanding event of the week has been the publication of a report that the production of Banca tin for the current year would only amount to 150,000 piculs, which is considerably less than was anticipated, and makes the market more easy of manipulation. The available supplies are now under very strong control, and although in view of the impending Banca sale quotations were temporarily depressed, the market has during the past day or two developed considerable strength. The margin between cash and forward metal is considerable, the prices quoted yesterday being respectively £137 10s. and £134 15s.

In the Lead section holders have played a waiting game with the result that buyers had to advance their prices. Manufacturers are rather more busy, and as stocks are low a further improvement in quotations may be anticipated. The market was quietly firm yesterday, closing prices being soft foreign prompt £12 10s., English £12 15s.

Spelter is lower, the poor character of the demand having induced holders to make some concession in the matter of price. The quotation for spot metal has been down to £23 7s. 6d., but some recovery from this quotation is to be noted,

In the Iron and Steel section, notwithstanding optimistic accounts from the United States our markets have been a little unsettled. Fluctuations, however, have been within comparatively narrow limits, and the closing price of Cleveland yesterday, 49s. 1d. cash, shows only a small decline on the week.

IRON, STEEL, PIG-IRON, &c.

SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as follows. Prices delivered in Glasgow or equal:—

Steel:		£	s.	d.
DALZELL	Siemens' Steel Plates, Marine Boiler Quality ..	6	15	0
♛♛	" " " Land " " ...	6	17	6
STEEL	" Steel Bars, Boiler Quality	6	17	6
DALZELL	Siemens' Steel Plates, Ship Quality Plates......	5	17	6
♛	" " Bars " "	6	7	6
STEEL	" " Angles............................	5	7	6

Manufactured Iron:

	£	s.	d.
Bars—Dalzell..	6	2	6
" Best	6	12	6
" " Horseshoe	6	12	6
" Angle..	6	2	6
" Best Angle	6	12	6
" Best Best	7	2	6
" Extra Best	7	12	6

Usual terms and extras. Special rates for delivery in England and export. The above prices subject to alteration without notice.

The Glasgow Iron and Steel Co., Ltd., Wishaw, quote as under (prices are delivered Glasgow or equal):—

	£	s.	d.	
Steel Angles (Glasgow ♔ Steel)...............	5	7	6	per ton.
Steel Ship Plates (Glasgow ♔ Steel)	5	17	6	"
Steel Bars, Ship Quality (Glasgow ♔ Steel)	6	7	6	"
Steel Bars, Boiler Quality (Glasgow ♛ ♛ Steel)	6	17	6	"
Steel Land Boiler Plates (Glasgow ♛ ♛ Steel)	6	7	6	"
Steel Marine Boiler Plates (Glasgow ♛ ♛ Steel)	6	7	6	"

Less 5 per cent. discount. Extras as per standard list.

Special prices for delivery in England and for export. The above prices subject to alteration without notice.

John Spencer (Coatbridge), Ltd., Phœnix Ironworks, Coatbridge, N.B., quote:—

	£	s.	d.
Bars—Phœnix	6	5	0
" Best..	6	15	0
" Best Best	7	5	0
" Extra Best..	7	15	0
" Best Horse Shoe	6	15	0
" Extra B.H.S.	7	15	0
" Extra Best Cable	8	5	0
" Rivet	6	5	0
" Best Scrap Rivet	7	5	0

	£	s.	d.
Angles—Phœnix	6	5	0
,, **Best**	6	15	0
,, **Extra Best**	7	5	0
Gas Tube Hoops—Phœnix Best	6	15	0
Plates—Phœnix	—		
,, Best Boiler	7	10	0
,, Best Best Boiler	8	0	0
,, Extra Best Boiler	9	0	0
Boiler Tube Strips—Phœnix Best Best	8	0	0

All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly.

Messrs. R. Feldtmann and Co., of Glasgow, quote Commission extra).

Pig Iron:	No. 1.			No. 8.		
	£	s.	d.	£	s.	d.
Coltness, f.a.s. Glasgow	3	4	6	2	14	0
Gartsherrie ,,	2	19	0	2	14	0
Summerlee ,,	2	19	0	2	14	0
Carnbroe ,,	2	16	6	2	12	6
Langloan ,,	3	4	0	2	15	0
Calder ,,	2	19	0	—		
Clyde ,,	2	18	6	2	13	6
Glengarnock, f.o.b. Ardrossan	2	18	0	2	12	6
Eglinton ,, ,,	2	14	6	2	12	6
Dalmellington, ,, Ayr	2	14	6	2	12	6
Shotts ,, Leith	2	19	0	2	14	6

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, **at works:**—

	£	s.	d.
W.W. Bars	6	12	6
W.W. Best Bars	7	2	6
W.W. Best Best	7	12	6
W.W. Best Best Best	8	2	6
W.W. Best Shoe	7	2	6
Thornaby	8	2	6
Thornaby Best	8	12	6
Thornaby Best Best	9	12	6
Whitwell Special Admiralty Cable	10	5	0
Special Chain Iron	9	5	0
Tube and Nail Strips	6	15	0
W.W. Angle Iron	6	15	0
W.W. Best Angle Iron	7	5	0
Tee Iron, to 8-inches United	7	12	6

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd. Dallam and Bewsey Forges, Warrington, quote:—

		Iron.			Steel.		
		£	s	d.	£	s.	d.
W.I.W	Bars	6	10	0	6	15	0
	Angles	7	0	0	7	5	0
	Tees	7	10	0	7	15	0
	Hoops	7	0	0	7	10	0
	Sheets	7	10	0	8	0	0

Ordinary Sizes, F.A.S. Liverpool in 10-ton Lots
Extras for Sizes and Cutting as per List.

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

Black Sheets:	Singles 20 G 96in. by 36in. per ton.			Doubles 21 G to 24 G 96in. by 36in. per ton.		
	£	s.	d.	£	s.	d.
"Vale"	10	0	0	10	10	0
"Shield"	10	10	0	11	10	0
"Severn"	11	10	0	12	10	0
"Baldwin Wilden B."	12	10	0	13	10	0
Charcoal	16	10	0	17	10	0
Best Charcoal	18	10	0	19	10	0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:						
	£	s.	d.	£	s.	d.
No. 3 Lead	13	10	0	14	10	0
S.V. Lead	15	0	0	16	0	0
No. 3 Terne	15	0	0	16	0	0
S.V. Terne	16	10	0	17	10	0

Tinned Sheets:	Singles 20 G to 108 by 36in. per ton.			Doubles 21 to 24 G to 96 by 36in. per ton.		
	£	s.	d.	£	s.	d.
Best Coke (Finish)	28	0	0	29	10	0
,, Charcoal (Finish)	30	0	0	31	10	0
Extra ,, ,,	32	0	0	33	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.

Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box.

Extreme sizes in Tin and Patent Coated specially quoted for.

Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.

At works less 2½% for cash monthly, 10th inst.

Galvanized Corrugated Sheets:

	£	s.	d.	
"Phœnix" Brand, 24 G., f.o.b. London, in Bundles	11	12	6	per ton.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	14	5	0	,,

Galvanized Working Up-Sheets:

	£	s.	d.	
24 G., f.o.b. London, in Bundles	13	12	6	per ton.

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£	s.	d.	
Crown Bars	6	10	0	per ton.
Best Bars (1 to 6in. wide, above ½ in. thick, ½ in. to 4 rounds and squares)	7	0	0	,,
Angles	6	15	0	,,
,, Best	7	5	0	,,
T's	7	0	0	,,
,, Best	7	10	0	,,
Best Shoe Iron	8	0	0	,,
,, Rivet Iron	8	0	0	,,
,, Best Rivet (Special)	9	5	0	,,
,, Cable	9	5	0	,,
,, Screwing	8	5	0	,,

	£	s.	d.	
Best Turning	8	0	0	per ton.
,, Plating	8	5	0	,,
Best Best	9	5	0	,,
Treble Best	10	5	0	,,
Plates	7	10	0	,,
Best Plates	8	0	0	,,
,, Boiler Plates	8	10	0	,,
,, Best Boiler Plates	9	10	0	,,
Treble Best Boiler Plates	12	0	0	,,

Delivery f.o.b. Liverpool, Birkenhead or Manchester.

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon., quote "Star" brand patent wrought nails, steel nails, &c.

Discounts—

45 per cent. off 1-inch to 3-inch strong rose and all fine rose and 6dy. and 8dy. pound.

40 per cent. off 3½ inch to 7-inch strong rose and 10dy. and 20dy. pound.

40 per cent. off all sharp-pointed nails.

Delivered in lots of 4 cwt. and upwards. Extra 2½ per cent. discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis:—

2 tons 9/6 per cwt.
4 cwt. lots and upwards 9/9 per cwt. } d/d any Railway Station.

Steel cut nails, 3-inch basis—

2 tons 8/3 per cwt.
4 cwt. lots 8/6 per cwt. } d/d any Railway Station.

Slit rods (iron) £7 10s. per ton, at works for 2-ton lots.

Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E. C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla, quote:—

	Per Box. f.o.b. Wales. £	s.	d.
Coke Tin-plates.			
C 18¾ by 14 124s. 110 lb. "BV"	0	12	0
C 20 by 10 225s. 155 ,, "Jumbo"	0	17	0
C 20 by 14 112s. 108 ,, "Lydbrook"	0	11	9
C 28 by 20 112s. 216 ,, "Lydbrook"	1	3	9
Charcoal Tinplates:			
C 20 by 14 112s. 108 lb. "Allaway"	0	12	6

BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes:—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

	£	s.	d	
Steel:				
Blooms	at 3	14	0	per ton.
Billets	at 3	16	0	,,
Sheet Bars	at 3	18	0	,,
Finished Steel:				
Bars	at 5	1	0	per ton.
Angles	at 5	2	0	,,
Tees	at 5	5	0	,,
Joists	at 4	10	0	,,
Fencing Standards	at 5	2	0	,,
Shoeing Bars	at 5	4	0	,,
Tyre Bars	at 5	4	0	,,
Half-Round Bars	at 5	5	0	,,
Heavy Rails	at 4	15	0	,,
Light Rails	at 4	17	6	,,

Structural Steelwork:

Prices on application.

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote:—

TIN.

Tin:	£	s.	d.		£	s.	d.	
English Ingots, f.o.b. Dis. 1½% & 1%	186	10	0	to	187	0	0	per ton.
English Bars, f.o.b. Dis. 1½% & 1%	187	10	0	to	188	0	0	,,
Straits G.M.B., cash Warehouse, Net	186	17	6	to	187	0	0	,,
Straits G.M.B., 3 months, Warehouse, Net	184	15	0	to	185	0	0	,,
Australian, Mt. Bischoff, Warehouse, Net	186	17	6	to	187	12	6	,,

COPPER.

Copper:	£	s.	d.		£	s.	d.	
Standard G.M.B., cash Warehouse, Net	67	15	0	to	67	17	6	per ton.
Standard G.M.B., 3 months, Warehouse, Net	68	5	0	to	68	6	3	,,
English, Tough, Cake & Ingot, Warehouses, Net	71	0	0	to	71	10	0	,,
English, Best Select, Warehouse Net	72	0	0	to	72	10	0	,,
English, Sheets and Sheathing, f.o.b., Dis. 2½%	81	0	0	to	82	0	0	,,
English, Sheets for India, f.o.b., Dis. 2½%	76	0	0	to	76	10	0	,,
Electro, Warehouse, Net	70	15	0	to	71	0	0	,,
Ore, ex. ship	0	12	0	to	0	13	0	per unit.
Regulus, Matte and Precipitate, ex. ship,	0	13	3	to	0	14	0	,,

YELLOW METAL.

Yellow Metal:	£	s.	d.	£	s.	d.	
Sheets, 4 by 4 feet for India f.o.b. Dis. 2½%				0	0	6¼	per lb.
Sheathing ,, ,,				0	0	6⅛	,,

SPELTER.

	£	s.	d.		£	s.	d.	
Silesian outports, Net	23	10	0	to	23	15	0	per ton
Blende of 50 % Net	6	11	6	to	6	15	0	,,
Calamine, Net	6	14	0	to	6	15	0	,,

LEAD.

	£	s.	d.		£	s.	d.	
English Pig, Warehouse, Dis. 2½%	12	15	0	to	12	17	6	per ton.
Spanish, ex ship, Dis. 2½%	12	8	9	to	12	10	0	,,
Lead Ore of 70 %, Net	6	2	6	to		--		,,

ANTIMONY.

	£	s.	d.		£	s.	d.	
Star Regulus, f.o.b., Dis. 2½ %	35	0	0	to	36	0	0	per ton.
Ore, 50 %, ex ship, Dis. 2½%	8	10	0	to	9	10	0	,,
Crude, ex ship, Dis. 2½ %	15	0	0	to	17	10	0	,,

QUICKSILVER.

	£	s.	d.	
Spanish, 75 lb., Warehouse, Net	7	12	6	per flask.
Italian ,, ,, ,,	7	11	6	,,

COAL.

LEICESTERSHIRE.

The Nailstone Colliery Company, Leicester, quote. Price per Ton at Pit of 20 Cwt., with ½ Cwt. per Ton for wastage —

Upper Main Seam.	s.	d.
Main Coal	7	6
Best Hard Steam (hand picked, as used by the Railway Companies)	6	0
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)	6	0
Fine Slack	0	6

Terms, net cash on 10th of month following delivery.

DERBYSHIRE.

The Manners Colliery Co., Ltd., of Ilkeston quote as follows, per ton at pit:

Kilburn Coal:	s.	d.
Best London Brights	9	9
Large Nuts (1½ to 3½)	9	6
Small Nuts (¾ to 1½)	6	0
Rough Brights	6	0
Peas (⅜ to ¾)	5	0
Slack	3	6
Smudge	2	0

Low Main (or Tupton) Coal:		
Low Main Brights	7	6
,, ,, Nuts	7	3
Hards (Good Steam Coal)	8	0
Bakers' Nuts (1" to 2")	6	6
Slack	3	6

The Clay Cross Company's Collieries, Clay Cross, near Chesterfield, quote:—

	per ton at pit. s.	 d.
Best Main Coal	10	6
Best Silkstone	10	0
Best House Coal	8	6
Best House Nuts	8	0
Treble Screened Cobbles	7	9
Best Cobbles	7	3

NOTTINGHAMSHIRE.

The Digby Colliery Co., Ltd., near Nottingham, quote per ton at pit:—

Digby Coal:

STEAM.	s.	d.
Best Hand Picked Hard	9	0
Steam Hard	7	9
Hard Nuts	7	0

Gedling Colliery.

HIGH HAZEL.		
London Brights, 4 to 8 in. cube	12	0
Large Nuts, 2 to 4 in. cube	9	6
Small Nuts, ½ to 2 in. cube	5	6

STEAM.—TOP HARD.		
Best Hard	9	0
Hard Steam	8	0
Cobbles	7	0

CHEMICALS AND OILS.

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square, Manchester, quote:

	£	s.	d.	
Acids: Oxalic	0	0	2⅜	per lb.
Picric, Crystals	0	0	11	,,
Tartaric .... at Manchester	0	0	10½	,,

	£	s.	d.	
Acetate of Lime: Brown at Manchester net	9	10	0	per ton.
Grey ,, ,,	11	10	0	,,
Alumina: Alum, Lump, loose	5	5	0	,,
,, ,, in casks	5	7	6	,,
,, Ground, in bags	5	15	0	,,
Sulphate of Alumina, 14%	4	10	0	,,
Ammonia: Carbonate	0	0	3⅝	per lb.
Muriate Grey f.o.b. Liverpool	24	0	0	per ton.
Sal-ammoniac, Lump, 1sts, deld. U.K.	42	0	0	,,
,, ,, 2nds, ,,	40	0	0	,,
Sulphate .... f.o.b. Liverpool	12	15	0	,,
Arsenic: Best White Powdered ....net	12	7	6	,,
Bleaching Powder, 35% .... ,,	4	10	0	,,
Borax: British Refined Crystal......... ,,	12	0	0	,,

Coal Tar Products:				
Benzole, 50/90 % ,,	0	0	6	per gal.
,, 90% ,,	0	0	7	,,
Carbolic Acid Crystals, 34/35° C. ... ,,	0	0	6	per lb.
,, ,, ,, 39/40° C. ... ,,	0	0	6½	,,
,, ,, Liquid, 97/99 % ... ,,	0	0	9	per gal.
,, ,, Crude, 62½% at 60° F. f.o.b. ,,	0	1	9	,,
Creosote, ordinary good liquid...... ,,	0	0	1⅝	,,
Naphtha, Crude, 20 % at 120° C.... ,,	0	0	3	,,
,, Solvent, 90% at 160° C.f.o.b ,,	0	0	8	,,
,, ,, 95 % at 160° C. ,, ,,	0	0	9	,,
,, ,, 90 % at 190° C. ,, ,,	0	0	10	,,
,, Rectified, flash point over 73° F. ....f.o.b. ,,	0	0	11	,,
,, Rectified, flash point over 100° F. ....f.o.b. ,,		1	0	,,
Naphthalene, all qualities.				
Pitch..............f.a.s. Manchester. ,,	1	11	6	per ton.
Copperas: Green, in bulk .... ,,	0	12	6	,,
,, barrels f.o.b. L'pool ,,	1	19	0	,,
Cake............................ ,,	1	2	6	,,
Copper: Sulphate	22	0	0	,,
Cyanides: 98% minimum ......f.o.b. net	0	0	7½	per lb.
Lead: Acetate (Sugar) White, English......	27	10	0	per ton.
,, ,, ,, Foreign c.i.f. U.K	23	5	0	,,
,, ,, Grey	21	15	0	,,
,, ,, Brown at Manchester	17	0	0	,,
Nitrate	24	0	0	,,
Litharge, Flake	15	10	0	,,
,, Powder	16	0	0	,,
Red Lead, Genuine, c.i.f. London less 5%	15	10	0	,,
White ,, ,, Dry ,, ,, ,,	16	15	0	,,
Naphtha (Wood): Miscible, 60 o.p.	0	2	10	per gal.
Solvent..	0	2	7	,,
Potash: Bichromate... delivered England...	0	0	3	per lb.
Carbonate, 90/92 % ... c.i.f Hull ...	18	10	0	per ton.
Caustic, 75/80 % ...... ,, ,, ...	20	15	0	,,
Chlorate ....net	0	0	3⅛	per lb.
Montreal.........in Store, Liverpool	35	0	0	per ton.
Prussiate, Yellow ....net	0	0	5	per lb.

	£	s.	d.	
Soda: Ash, Caustic, 48 %, Ordinary ... net	5	5	0	per ton.
,, ,, ,, Refined...... ,,	6	5	0	,,
,, Carbonated, 48 %............ ,,	5	10	0	,,
,, ,, 58 % (Ammonia Alkali) ....net	4	10	0	,,
,, Bleachers' Refined Caustic 50/52 % .... net	6	10	0	,,
Caustic, White, 77 %............... ,,	10	10	0	,,
,, ,, 70 %............... ,,	9	12	6	,,
,, ,, 60 %............... ,,	8	12	6	,,
,, Cream, 60 %.............. ,,	8	10	0	,,
Crystals, in bags	3	0	0	,,
,, barrels	3	7	6	,,
Acetate .... c.i.f. Hull net	17	10	0	,,
Bicarbonate, in 1 cwt. kegs............	6	15	0	,,
Bichromate......delivered England...	0	0	2¼	per lb.
Chlorate .... net	0	0	3 1/16	per lb.
Nitrate...ex quay Liverpool, ... ,,	11	7	6	per ton.
Phosphate	9	5	0	,,
Prussiate ....net	0	0	3⅜	per lb.
Silicate, Solution, 140° Tw.	4	10	0	per ton.
Sulphate (Glauber Salts)...............	1	12	6	,,
,, (Saltcake, 95%)...............	1	15	0	,,
Sulphur: Recovered	4	15	0	,,
Roll	6	15	0	,,
Flowers................................	7	10	0	,,
Zinc: Sulphate	6	15	0	,,

MINERALS.

	£	s.	d.	
Barytes: Lump Carbonate, 90/92%	3	10	0	per ton.
Sulphate, No. 1, White	2	15	0	,,
China Clay: of various qualities for all purposes; prices from about 11/- to about 30/- per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid.				
Chrome Ore: Basis 50% c.i.f. British Ports...........	3	7	6	,,
Manganese: Lump c.i.f. Liverpool 10¼d.	per metallic unit.			
Ochre: French JC .... f.o.b. Rouen, net	2	5	0	per ton.
,, JF	5	10	0	,,
Talc: (French Chalk).........c.i.f. Liverpool	3	10	0	,,

OILS, etc.

	£	s.	d.	
Aniline Oil ....net	0	0	4⅜	per lb.
,, **Salt**.......... .... ,,	0	0	4½	,,
Castor Oil: French, 1st pressure, f.o.b. Marseilles less 1½%.........	22	15	0	per ton.
English, 1st pressure, f.o.r. Hull, less 2½%..............	28	0	0	,,
Cocoa Nut Oil: Ceylon, ex store Manchester..............net	29	10	0	,,
Cochin, ex store Manchester . ...net	32	0	0	,,
Cotton Seed Oil: Refined at Hull, less 2½% naked	13	15	0	,,
Edible...at Hull, less 2½% naked	14	5	0	,,
Glycerine: Crude, 80% .... net	31	0	0	,,
Linseed Oil: Raw... ..at Hull, less 2½% naked	14	5	0	,,
Boiled......at Hull less 2½% naked	15	5	0	,,
Starch: American Pearl...at Manchester, net	8	15	0	,,
Dextrine........... ,, ,,	17	15	0	,,
Farina.............. ,, ,,	15	10	0	,,
Shellac: Standard TN orange spot	147/-			per cwt.
Turpentine: American.........at Liverpool	38	0	0	per ton.
Russian ....at Hull...net	19	0	0	

TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote:—

COLONIAL WOODS.

Timber.

		£	s.	d.		£	s.	d.
Quebec Square White Pine...	per cub. ft.	0	1	9	to	0	3	0
Quebec Waney Board Pine...	,,	0	2	8		0	3	9
St. John Pine, 18 in. average	,,	0	2	4		0	3	3
Lower Ports Pine................	,,	0	1	3		0	1	8
Quebec Red Pine	,,	0	1	6		0	2	0
Quebec Oak, 1st quality	,,	0	2	9		0	3	4
Quebec Oak, 2nd quality ...	,,	0	1	6		0	2	6
Ash	,,	0	1	6		0	2	3
Elm	,,	0	3	3		0	3	10
Hickory	,,	0	2	0		0	2	6
Quebec Birch	,,	0	1	6		0	2	3
St. John Birch	,,	0	1	6		0	2	0
Birch Planks....................	,,	0	0	9		0	0	11
Spruce Spars	,,	0	0	10		0	1	0

Deals.

		£	s.	d.		£	s.	d.
1st quality Quebec Pine	per std.	22	10	0	to	32	10	0
2nd do. do.	,,	17	0	0		22	0	0
3rd do. do	,,	11	10	0		13	0	0
St. John, N.B., etc., Spruce	,,	6	15	0		7	5	0
Lower Ports Spruce..	,,	6	10	0		6	15	0
Spruce Boards................	,,	5	10	0		6	0	0

UNITED STATES, etc., WOODS.

Pitch Pine.

		£	s.	d.		£	s.	d.
Hewn	per cub. ft.	0	1	4	to	0	1	8
Sawn	,,	0	0	11		0	1	6
Planks, Stowage	,,	0	0	10		0	1	0
Boards, Prime	per std.	12	10	0		16	0	0
Oak Timber	per cub. ft.	0	1	6		0	2	6
Oak Planks	,,	0	1	6		0	2	1
East India Teak............	per load	12	0	0		16	0	0
Greenheart.....	,,	6	15	0		7	10	0

EUROPEAN WOODS.

Timber.

		£	s.	d.		£	s.	d.
Riga Redwood	per cub. ft.	0	1	6	to	0	2	0
Dantzic and Memel Fir, Crown	,,	0	2	1		0	2	6
Dantzic and Memel Fir, Middling	,,	0	1	9		0	1	11
Stettin	,,	0	1	9		0	1	11
Swedish......................... ...	,,	0	1	0		0	1	3
Riga Whitewood	,,	0	1	0		0	1	3
Norway Mining Timber	,,	0	0	9		0	1	0
Dantzic and Stettin, etc., Oak..	,,	0	2	6		0	3	0
Norway Spars................	,,	0	1	2		0	1	9

Deals.

		£	s.	d.		£	s.	d.
Red Archangel and Onega, 1st quality	per std.	19	0	0		20	0	0
Red Archangel and Onega, 2nd quality	,,	14	0	0		16	0	0
Red Archangel and Onega, 3rd quality	,,	10	10	0		12	10	0
St. Petersburg, 1st quality...	,,	16	0	0		17	10	0
Do. 2nd ,, ...	,,	14	0	0		15	0	0
Gefle	,,	11	10	0		16	0	0
Wyburg	,,	11	0	0		12	10	0
Uleaborg	,,	10	0	0		12	10	0
Gothenburg	,,	11	0	0		16	0	0

SELECTED PATENTS.

Compiled expressly for this journal by **Messrs. Page and Rowlingson, Engineering Patent Agents, 28, New Bridge Street, London, E.C.,** and at Manchester.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton Buildings, Chancery Lane, W.C., at the uniform price of 8d.

NEW PATENTS APPLIED FOR.

When Patents have been communicated the names of the communicators are printed in *italics.*

5190. M. J. Roberts, London. March 13th.—Improvements in stern tubes of steamships and the like.

5212. P. B. Massey, Leeds. March 13th.—Spanner.

5218. O. B. Craft, London. March 13th.—Improvements in wrenches.

5219. H. Davey, London. March 13th.—Steam turbines.

5241. M. J. Kilroy, London. March 13th.—Improvements in metallic packings for the pistons of steam and other engines and pumps.

5246. G. W. Morrison, London. March 13th.—A gas or the like turbine.

5251. J. B. Smith, London. March 13th.—Improvements in automatic wrenches.

5274. D. C. Smith, Glasgow. March 14th.—Improvements in and relating to compounds for removing incrustation from steam boilers and the like.

5276. G. H. Wright, Derby. March 14th.—Improvements in brakes for railway goods wagons and the like.

5318. C. J. Rousseau and E. C. Ferris, London. March 14th.—Improvements in oil engines.

5330. P. B. W. Kershaw, London. March 14th.—Improvements in or relating to internal combustion engines and fluid pressure turbines.

5347. T. Clarkson, London. March 14th.—Improvements in or relating to steam generators.

5363. A. M. Descours-Desacres, London. March 14th.—Means for locking together screw nuts and bolts. (Date applied for June 3rd, 1904.)

5372. V. Ranalli, London. March 14th.—Improvement in external gas furnaces for stationary and marine steam boilers.

5412. A. Blackwell, T. Harrison, and G. Harrison, Birmingham. March 15th.—Improvements in machinery for rolling metals.

5413. K. Stewart, Glasgow. March 15th.—Improvements in and relating to the propulsion of ships or other vessels.

5424. W. Kneen, London. March 15th.—Improvements in gearing for the transmission of rotary motion.

5433. J. Henry and A. Anderson, London. March 15th.—An improved furnace grate.

5443. F. Gregory, London. March 15th.—Improvements in locking nuts for bolts, studs and the like.

5546. A. L. Hitchcock-Spencer and P. A. Sharman, London. March 16th.—Improvements in vertical steam boilers.

5549. W. J. Gordon and J. McKechnie, London. March 16th.—Improvements in and relating to piston rings.

5586. The British-Thomson Houston Co., Ltd., London. March 16th.—Improvements in multiple cylinder engines. (*General Electric Co., U.S.A.*)

5602. W Rowbotham and I. M. C. J. de Havilland, Birmingham. March 17th.—Improvements in and relating to hot air or increased volume turbines.

5604. W. Rowbotham and I. M. C. J. de Havilland, Birmingham. March 17th.—Improvein and connected with turbines.

5615. F. Chorlton, Manchester. March 17th.—An improved plug or valve.

5626. M. Buch, Coventry. March 17th.—Improvements in or relating to worm-gearing.

5627. E. W. Whitley, Leeds. March 17th.—Improvements in metal sawing machines.

5628. W. E. Barnes, London. March 17th.—Improvements in thermostatic valves. (Date applied for March 17th, 1904.)

5651. H. Sykes, Ltd., and E. Jackson, London. March 17th.—Improvements relating to pumping engines.

5666. C. E. Finch, London. March 17th.—Improvements in automatic boiler feeders.

5674. L. K. Clark, London. March 17th.—Improvements in driving mechanism.

5678. Maschinenfabrik Grevenbroich, Liverpool. March 17th. (Date applied for April 23rd, 1904.)

5683. W. W. Pagett and E. J. Guest, Stourbridge. March 18th.—An improved speed indicator for registering the speed of motors, motor-cars, motor-buses, steam-engines or other like machines, showing speed at any moment and also maximum speed attained.

5699. J. H. Walker, Liverpool. March 18th.—Improvements in boring or distilling tools. (*G. R. Ray, U.S.A.*)

5701. D. McGee, Glasgow. March 18th.—Improvements in and relating to the furnaces of steam boilers.

RECENT SPECIFICATIONS.

BALANCING DEVICES FOR HIGH-SPEED MOTORS AND MACHINES.

Sebastian Ziani de Ferranti, of London. Feb. 24th, 1904.—This invention relates to high-speed motors, such as turbines, and has for its object the provision of means for accurately balancing such rotating bodies about their axes. The invention consists in adjustably mounting balance weights on the rotating body on opposite sides of the line in which compensation is required and moving these weights circumferentially so that correct balancing is obtained. In carrying the invention into effect, equal balance-weights are provided, together with means whereby these weights may be attached to the rotating part respectively at any point of a circle described about the axis of rotation. Balancing the rotating parts of high-speed motors is thus obtained by adjustably mounting two or more weights on the rotating part to be balanced, and moving these weights circumferentially, so that correct balance is obtained without requiring alteration either of the amount of the weights or their distance from the axis.

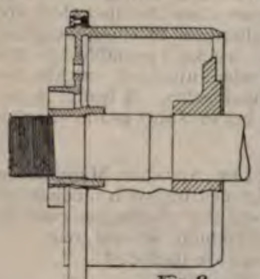


Fig. 2

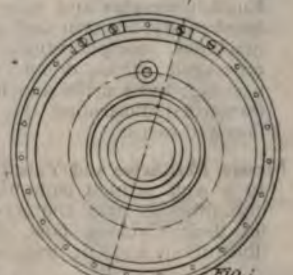


Fig. 1

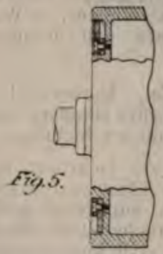


Fig. 5.

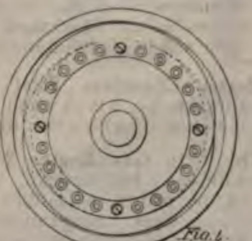


Fig. 4.

TREATMENT OF EXHAUST STEAM AND FEED-WATER.

Archibald Edward Dobbs, Arthur Frederick Dobbs, and James Borthwick Kerr, of London. March 18th, 1904.—This invention relates to the treatment of exhaust steam and feed water, and is especially applicable to steam-propelled vehicles, launches and the like, where the supply of fresh water is limited. It is found in practice on steam-driven vehicles that the condenser does not always completely condense the exhaust steam, and the working of the return water-feed pump is consequently interfered with. One object of the present invention is to obviate this difficulty. Other objects are to eliminate the oil carried over from the engine. According to the invention the exhaust steam is first led to an oil separator, wherein it is allowed to whirl in contact with spirally arranged baffle plates, and the oil thereby separated centrifugally and thrown down. The steam so far separated is passed on to the condenser from which the condensed and uncondensed steam is led to a water separator, wherein it is also caused to attain a whirling motion in contact with gauze or like baffles in order to separate the water. The remaining steam is then passed on through a sinuous pipe to the feed tank, but before entering the same it is caused to pass through a filter adapted to thoroughly eliminate any oil still remaining.

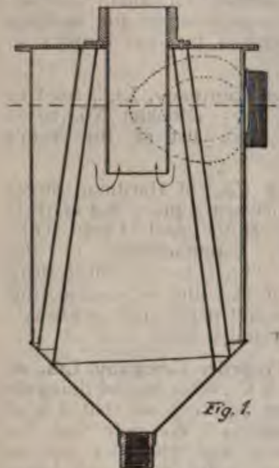


Fig. 1.

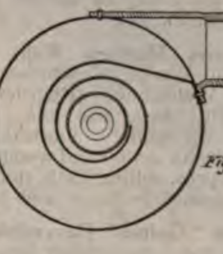


Fig. 2.

VERTICAL STEAM BOILERS.

Stephen Evans Alley, of Glasgow. April 14th, 1904. This invention has reference to and comprises improvements in and relating to vertical steam boilers, more particularly those designed for use for steam motor-wagons, and in which the water space is formed between an outer circular shell and an inner shell which is partly square or rectangular, in which are fitted a number of series of transverse water tubes crossing each other at right angles within the combustion space of fire box. The tubes are preferably fitted with a slight inclination from one side to the other to assist circulation of the water and may have gutter-shaped covers fitted over the ends, those at the lower ends having the open part turned downward and those at the higher end turned upward to assist in directing the flow of the water. The improvements of this invention consist in providing for the stoking from the upper part of the boiler down a central tube or passage and the arrangement of the inner shell of the boiler and of the water tubes to permit of this. The transverse tubes are fitted in series on each side of the stoking tube and the series of tubes are placed alternately at right angles to each other and so arranged as to leave an open space for the stoking tube. In figs. 1 and 2 the tubes are shown as fitted with gutter-shaped covers to assist in directing the flow of the water through the tubes which are set at a slight inclination for the same purpose. These covers may however be dispensed with.

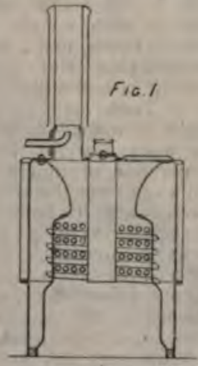


Fig. 1

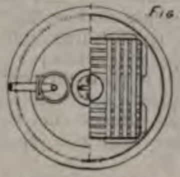


Fig. 2.

NEW PUBLICATIONS.

"THE IMPERIAL DIRECTORY AND STATISTICS OF ELECTRIC LIGHTING, POWER, AND TRACTION WORKS."

Great Britain, and Ireland, India, and all British Colonies. Hazell, Watson, and Viney, Ltd. 12s. 6d. net.

This most useful directory contains in a concise and very accessible form the latest particulars of the various electrical engineering schemes in operation or projected throughout the British Empire. The inclusion of a vast amount of new matter dealing with the electric lighting, power, and traction works in India and the Colonies, has necessitated a considerable enlargement of this year's volume, which is divided into two main sections; the first covers lighting and power, tramways, light railways, standard gauge, and tube railways of Great Britain and Ireland; the second section is devoted to electrical affairs in the British Colonies and Dependencies.

The details given in each section of the work are subdivided into several heads, first a statement as to the owners of the undertaking and the powers under which the undertaking is authorised, either by Act of Parliament, Board of Trade, etc.; and then follows a list of the committees of management where the local authority own the works, or the board of directors who control the operation of limited or incorporated companies; and in each case the names of the responsible officers connected with the technical and commercial departments of each works are given. The technical portion of the works is minutely described, first, as to the system used (three-wire, alternating, etc.); then follows a short account of the machinery, cables, and meters in use, with the names of the manufacturers and the type of engine, dynamo, or cable used. This classification of the power-house and distributing equipment is useful to everyone connected with the management of these undertakings, as affording a friendly comparison between the different works in operation, and a general guide to those towns where the statutory powers are not yet put into operation. There are several other features of permanent interest included in the Directory which appear to have been compiled with painstaking accuracy.

"THE INVENTOR'S GUIDE TO PATENT LAW AND THE NEW PRACTICE."

By James Roberts, M.A., LL.B. John Murray. 2s. 6d. net.

We have called attention on a previous occasion to Mr. Roberts larger work on "The Grant and Validity of British Patents for Inventions," of which the present volume is practically an epitome. It has been specially compiled, with regard to applications made under the new Act, for those who require a lucid explanation of the law and rules governing the grant of patents in the United Kingdom. Information on how to avoid the risk and consequences of premature disclosure of ideas is given, and the writer has successfully compressed the gist of the law relating to this subject into a very small compass, while he indicates reliable sources for those who wish to follow up any special point.

BOOKS RECEIVED.

"The Home Mechanic." By John Wright. John Murray. 6s. net.

"Work." Half-Yearly Volume. Cassell and Co. 4s. 6d.

NEW CATALOGUES.

The Fairbanks Company, 78-80, City Road, E.C., forward a useful table for converting American dollars into English pounds. Rules for converting Metric to English weights and measures are also included, and incidentally the firm call attention to their weighing machines, weighbridges, trucks, portable forges, renewable valves, double tube injectors, vulcabeston packing, twist drills and hack saws. A leaflet is also forwarded illustrating the horse shoe brand Arcade files and rasps.

Messrs. Matthews and Yates, Ltd., Swinton, Manchester. In a well printed pamphlet dealing with mechanical draught, this firm enumerate the advantages claimed for their Cyclone fans, of which several half-tone illustrations and line drawings are included.

The British Accumulator Company, Ltd., of Parliament Mansions, Victoria Street, Westminster, S.W., by means of an illustrated post-card, call attention to their solid cast Planté plates.

Messrs. Chambers, Scott and Co., Motherwell, N.B. Circular No. 6 is devoted to the firm's standard electric winches, of which two illustrations are included.

The Otto Gas Engine Works, 360, Dearborn Street, Chicago. Bulletin No. 2 is an illustrated price list of the firm's specialities for the supply of water to locomotives. Illustrations are included of the Otto Stand Pipe, as well as of new style long radius tank fixtures, new balanced Otto tank valve, Snow-Milne Slow-Closing Valve Device, etc. From the same we have received a leaflet enumerating the advantages claimed for Battelle's Dry Chemical Fire Extinguisher.

Messrs. H. Sotheran and Co., Booksellers, 140, Strand, W.C. Bibliotheca Chemico-Mathematica—an interesting catalogue of second-hand scientific books, including the library of the late Professor Alexander William Williamson, F.R.S., with an appendix of English and Foreign standard works on the exact sciences.

Messrs. Mather and Platt, of Salford Iron Works, Manchester, have issued a third edition of their catalogue of "D" Type Dynamos for small outputs. We note that this has been extended by the addition of three new sizes of machines to cover outputs up to 100 kilowatts.

The Simplex Steel Conduit Company, Ltd., send us the Simplex Pocket List, 1905 (Booklet No. 103—7500-3-05), an illustrated price list of the firm's manufactures.

Messrs. Matthew Wells and Co., of Hardman Street Oil Works, Manchester, forward a price list of their "Wellsaline" (Registered) Motor and Cycle Oils. This firm are the sole manufacturers of the "Wellsaline" lubricants, which include lubricating oils for cotton and woollen mills, collieries, engineering works, rolling mills, timber and paper mills, railways, steamships, corn and flour mills, etc.

The "Gaines" Reversible Propeller Company, Ltd., of 6 and 7, Stonecutter Street, E.C., describe and illustrate their propeller in a booklet, pointing out that it is of British manufacture throughout. We note that the firm also supply manganese and phosphor bronze hollow shafting, ball races, solid steel and brass shafting, and thrust blocks for all powers.

Messrs. T. D. Robinson and Co., Ltd., of Derby, forward their price list of rivets, bolts, etc.

PAGE'S WEEKLY.—January 6, 1905. Thin Paper Copy.

NO. 17. VOL. 6. SIXPENCE. FRIDAY, JANUARY 6, 1905.
(New Series. No. 13. Vol. I.) (REGISTERED AS A NEWSPAPER.)

Contains 1 p. of index

422304

PAGE'S WEEKLY

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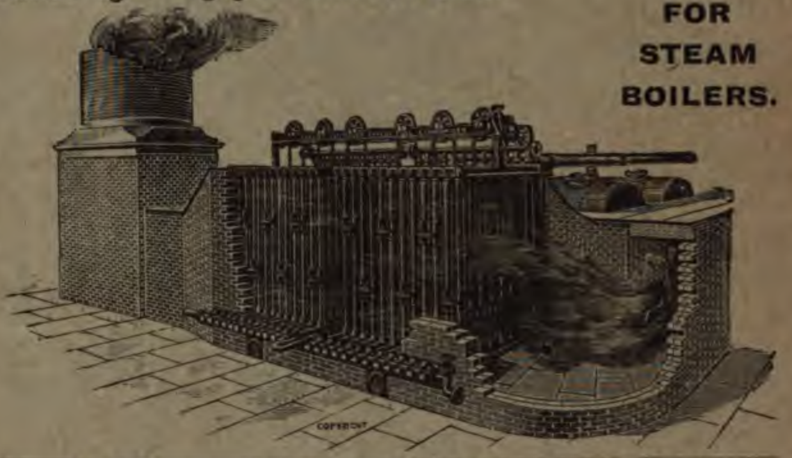

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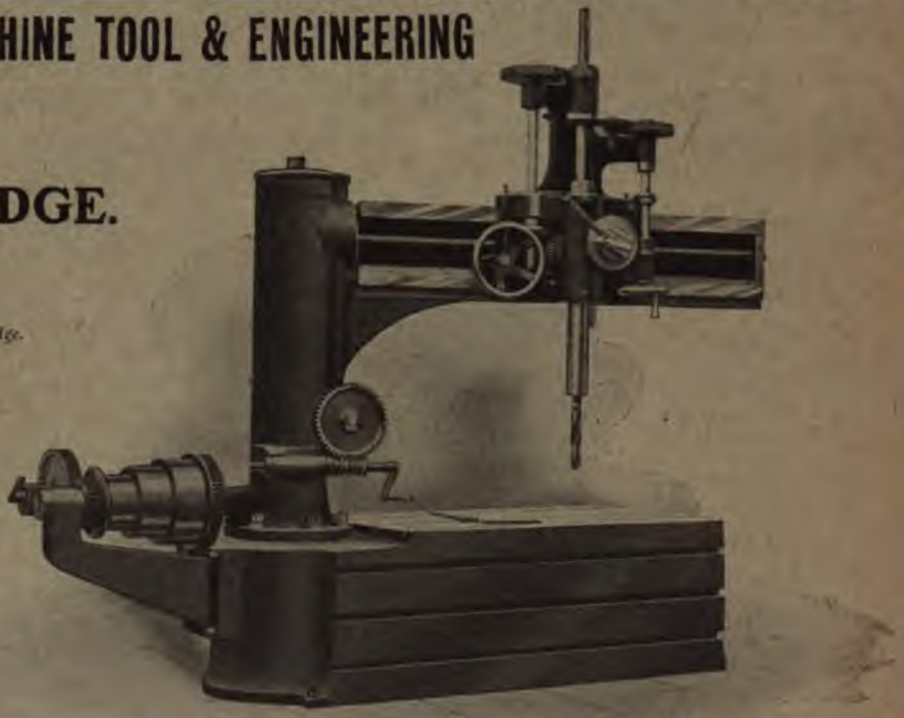

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PAGE'S WEEKLY.—January 13, 1905. This Paper Copy for Circulation Abroad.

No. 18. Vol. 6.

SIXPENCE.
(Registered as a Newspaper.)

FRIDAY,
JANUARY 13, 190

PAGE'S WEEKLY

ENGINEERING · ELECTRICITY SHIPBUILDING MINING IRON & STEEL INDUSTRIES

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NO. 19. VOL. 6. SIXPENCE. (REGISTERED AS A NEWSPAPER.) FRIDAY, JANUARY 20, 1905.

PAGE'S WEEKLY

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ESTABLISHED 1857.

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(Registered as a Newspaper.)   FRIDAY,
JANUARY 27, 1905.

PAGE'S WEEKLY

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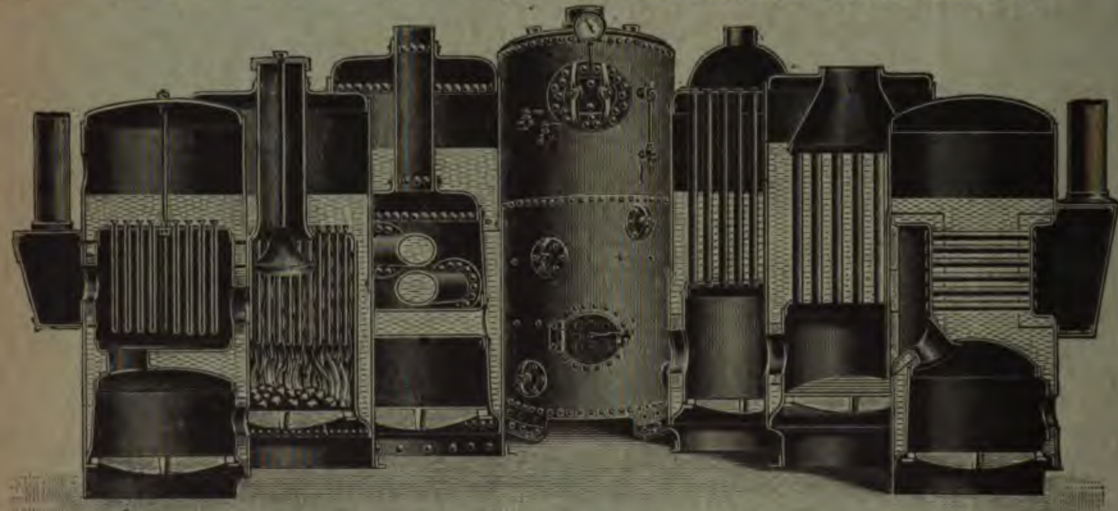

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PAGE'S WEEKLY.—February 3, 1905. Thin Paper Copy for Circulation Abroad.

No. 21. Vol. 6.

SIXPENCE.
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FRIDAY,
FEBRUARY 3, 1905.

PAGE'S WEEKLY

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FRIDAY,
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PAGE'S WEEKLY

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FRIDAY,
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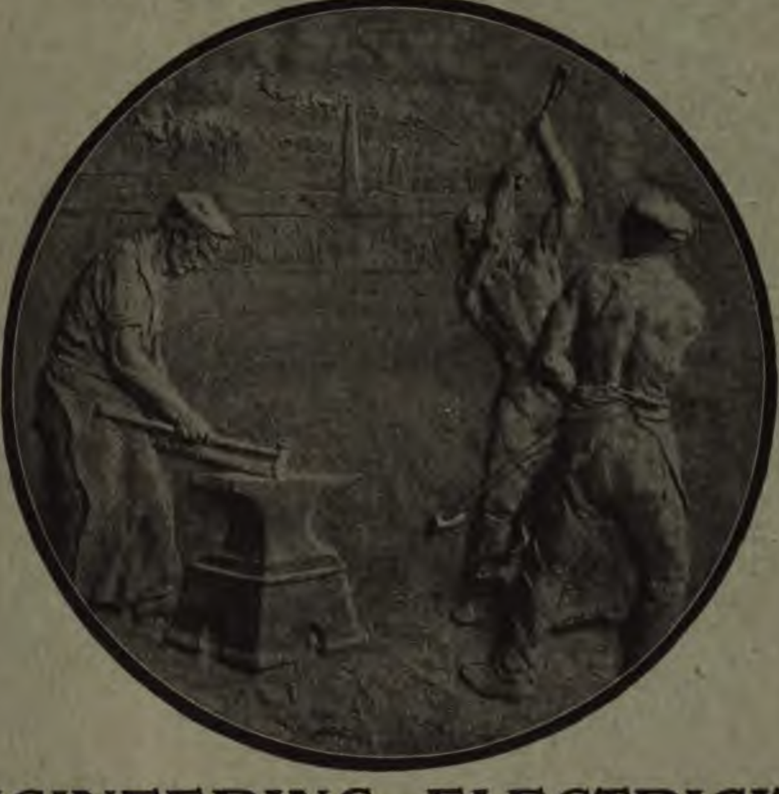

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Wheels and Axle before being put to work, shown for comparison.

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No. 25. Vol. 6.
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FRIDAY,
MARCH 3, 1905.

PAGE'S WEEKLY

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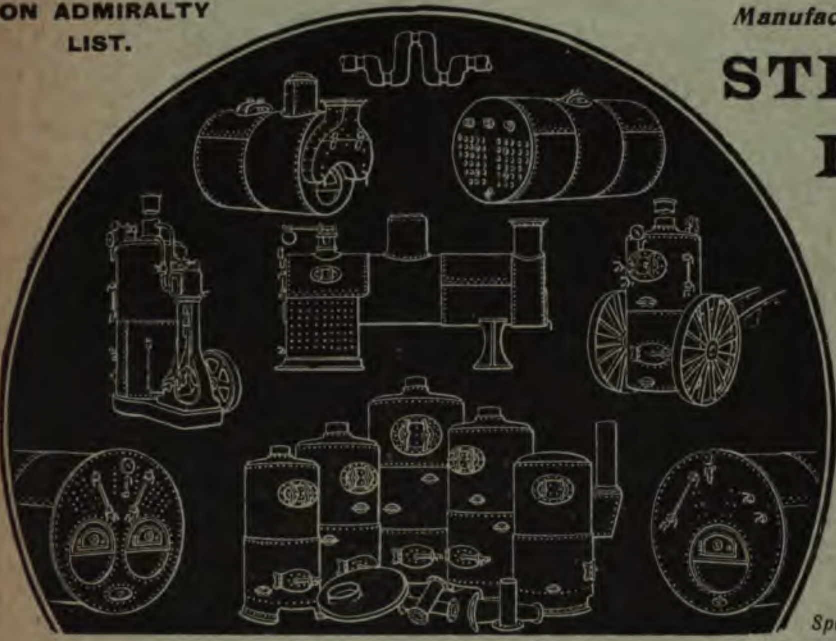

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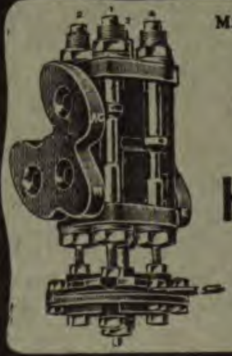

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PAGE'S WEEKLY Contracts

EAST INDIAN RAILWAY.—The East

Indian Railway Company is prepared to receive **TENDERS** for the **SUPPLY** and **DELIVERY** of :—

(1) **STEEL PLATES, ANGLES, BARS, etc.**;
(2) **FILES**;
(3) **PICKS, KODALIES, PHOWRAHS, and SHOVELS**;
(4) **HAMMER HANDLES and MALLETS**;

as per specifications to be seen at the Company's Offices.

Tenders are to be sent to the undersigned, marked "Tender for Steel Plates, etc.," or as the case may be, not later than Twelve o'clock noon on Wednesday, the 5th day of April next.

The Company reserves to itself the right to divide the order, also to decline any Tender without assigning a reason, and does not bind itself to accept the lowest or any Tender.

Fees, which cannot under any circumstances be returned, are charged, for the specifications as under, viz.: For Nos. 1 and 2, 21s. each, and for Nos. 3 and 4, 10s. 6d. each.

By order,
C. W. YOUNG,
Secretary.

Nicholas Lane, London, E.C.,
March 23rd, 1905.

CLYDE NAVIGATION.—TO BOILER-MAKERS.

BOILERS AND SUPERHEATING APPARATUS.

The Trustees of the Clyde Navigation invite **TENDERS** for **BOILERS** and **SUPERHEATING APPARATUS** for Electric Power Generating Plant at Clydebank Dock.

Copies of the specification and form of Tender are to be had at this Office, from Mr. Gec. H. Baxter, the Mechanical Engineer, on payment of £2 2s., which will be refunded on receipt of a *bona fide* Tender.

Sealed Tenders, marked "Tender for Boilers and Superheating Apparatus," to be lodged with the undersigned not later than noon on Monday, April 17th, 1905.

The Trustees may not accept the lowest or any Tender.

16, Robertson Street, Glasgow,
March 24th, 1905

T. R. MACKENZIE,
General Manager and Secretary.

CLYDE NAVIGATION.—TO SHIP-BUILDERS.

DREDGER.

The Trustees of the Clyde Navigation invite **TENDERS** for a **BOW-WELL CENTRE-LADDER SELF-PROPELLING DREDGER.**

Dawings may be seen, and copies of the specification and form of Tender obtained, on application at this office to Mr. Geo. H. Baxter, the Mechanical Engineer, on payment of £5 5s., which will be refunded on receipt of a *bona fide* Tender.

Sealed Tenders, marked "Tender for Dredger," to be lodged with the undersigned not later than noon on Monday, April 17th, 1905.

The Trustees may not accept the lowest or any Tender.

16, Robertson Street, Glasgow,
March 22nd, 1905.

T. R. MACKENZIE,
General Manager and Secretary.

BOROUGH OF HAMMERSMITH.

ELECTRICITY DEPARTMENT.

The Hammersmith Borough Council invite **TENDERS** for the **SUPPLY** of the following :—

1. **BOILER FLUES and ECONOMISERS.**
2. **HIGH-PRESSURE STEAM PIPES.**
3. **HIGH-PRESSURE FEED-WATER PIPES.**
4. **EXHAUST STEAM FEED-WATER HEATER and CIRCULATING WATER PIPES.**
5. **STEAM VALVES and FEED-WATER HEATERS**, and
6. **COAL ELEVATOR.**

Specifications and Forms of Tender can be obtained of the Borough Electrical Engineer, Mr. G. Gilbert Bell, Electricity Works, 85, Fulham Palace Road, W., upon payment of One Guinea, which will be returned upon receipt of a *bona fide* Tender.

Sealed Tenders to be endorsed and delivered to me at the Town Hall, Broadway, Hammersmith, not later than 4 p.m. on Wednesday, April 5th, 1905.

The Council does not bind itself to accept the lowest or any Tender.

March 14th, 1905. H. THOMPSON, Town Clerk.

BOROUGH OF BATLEY.—BRADFORD ROAD TRAMWAYS RECONSTRUCTION.

The Batley Corporation invite **TENDERS** for the following Works in connection with the Extension of the Tramways in Bradford Road :—

Contract No. 14.—**PERMANENT WAY CONSTRUCTION and PAVING.**
Contract No. 15.—**OVERHEAD EQUIPMENT, STEEL POLES, etc.**
Contract No. 16.—**FEEDER CABLES, CONDUITS, and ACCESSORIES.**

Copies of the General Conditions, Specifications, Quantities, Form of Tender and Drawings may be obtained from Messrs. Lacey, Sillar, and Leigh, 2, Queen Anne's Gate, Westminster, on and after the 29th inst., on payment of a deposit of £2 2s. in respect of each Contract, which will be returned on receipt of a *bona fide* Tender. Further copies of the Specification or Quantities can be obtained on payment of a further fee of Half-a-Guinea per copy, which will not be returned.

Tenders on the prescribed form, and endorsed "Tramways, Contract No. —," to be delivered at my office not later than April 17th proximo.

The Corporation do not bind themselves to accept the lowest or any Tender.

By order,
JOS. HANSON CRAIK,
Town Clerk.

Town Clerk's Office, Batley,
March 21st, 1905.

CITY OF ABERDEEN.—ELECTRICITY DEPARTMENT.

Tenders are invited for the Supply of **ONE SURFACE CONDENSER**, with Air Pump, Oil Separator, etc.

Specification, with General Conditions of Contract and Form of Tender may be obtained from the undersigned on and after 29th inst. on payment of £2, which sum will be returned upon receipt of a *bona fide* Tender.

Offers, endorsed "Tenders for Condenser," and addressed to the Engineer, must be delivered at or before noon on Wednesday, April 19th.

Corporation Electricity Works,
Millburn Street, Aberdeen.

J. ALEX. BELL,
City Electrical Engineer.

ARBROATH CORPORATION WATER-WORKS.

CONTRACTS Nos. 4 AND 5.

The Corporation are prepared to receive **TENDERS** for the following **WORKS**, in connection with the Noran Water Scheme :—

Contract No. 4.—Supplying and Laying about 7½ miles of Cast Iron Water Pipes between Framsdrum and Colliston, and the Construction of a Service Reservoir at Framsdrum.

Contract No. 5.—Supplying and Laying about four miles of Cast Iron Water Pipes between Colliston and Arbroath, and the Construction of a Service Reservoir at Muirheads, near Colliston.

The plans may be seen, on and after Saturday, the 25th March, at the office of the Engineers, Messrs. Crouch and Hogg, C.E., 53, Bothwell Street, Glasgow, from whom copies of the specification, schedule of quantities, and form of Tender may be obtained on payment of Two Guineas for each contract, which will be returned to everyone sending in a *bonâ fide* Tender.

An Assistant Engineer will meet intending contractors at Arbroath Station on arrival of the train due at 10.45 a.m. on Tuesday, the 28th March, to show them over the route.

Sealed Tenders, marked outside "Tender for Arbroath Waterworks," must be lodged with the undersigned, not later than 10 a.m. on Thursday, the 6th April.

The Corporation do not bind themselves to accept the lowest or any Tender.

W. K. MACDONALD,
Town Clerk Arbroath.

Arbroath, March 16th, 1905.

BOSTON UNION.—LAUNDRY FITTINGS, MACHINERY, ENGINE AND BOILER FOR NEW LAUNDRY AT THE WORKHOUSE, BOSTON.

The Guardians of the Poor of the Boston Union are prepared to receive **TENDERS** for **LAUNDRY FITTINGS, MACHINERY, ENGINE** and **BOILER** for the new Laundry proposed to be erected at the Workhouse, Boston.

Persons desirous of tendering for the above are to send in their names to the Architect, Mr. James Rowell, Church Lane, Boston, Lincolnshire, on or before March 25th, 1905.

Plans of the buildings and particulars of requirements may be inspected at the Architect's Office.

A copy of the plans of the buildings and requirements may, by arrangement with the Architect, be obtained on loan, on a deposit of £2, which sum will be returned on receipt of a *bonâ fide* Tender, &c., and the copy of plans and particulars, by time agreed.

Tenders, &c., to be sealed and endorsed "Tender for Laundry Machinery," and sent, addressed to the undersigned, not later than April 15th, 1905.

There is no undertaking to accept the lowest or any Tender, nor will any expenses be paid in connection therewith.

Clerk's Office,
28, Wide Bargate, Boston.
March 11th, 1905.

JOHN M. SIMPSON,
Clerk to the Guardians.

APPOINTMENTS OPEN.

INDIAN PUBLIC WORKS DEPARTMENT.

THE SECRETARY OF STATE FOR

India in Council will, in the Summer of 1905, make not less than **ELEVEN APPOINTMENTS** of **ASSISTANT ENGINEER** in the permanent establishment of the Indian Public Works Department in addition to the appointments to be made from Coopers Hill College.

The age of candidates must not be less than 21, or more than 24, years on the 1st July, 1905.

A printed form of application, together with information regarding the conditions of the appointments and certain requirements laid down as to education and experience in engineering may be obtained from the Secretary Public Department, India Office, Whitehall, London, S.W.

The form of application is to be returned not later than Monday 1st May next.

A. GODLEY,
Under Secretary of State.

India Office,
February 24th, 1905.

STOREKEEPER. — Wanted, Situation in

large Engineering Works, by thoroughly reliable and competent man; long experience, good stock and book-keeper; excellent references.—Progressive, 28, Osborne Road, Sharrow, Sheffield.

BUYERS' DIRECTORY.

NOTE.—The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index to Advertisers on pages 23, *and* 25.

In order to assure fair treatment to advertisers, each firm is indexed under its leading speciality ONLY.

Advertisers who prefer, however, to be entered under two or more different sections can do so by an annual payment of 5s. *for each additional section.*

Artesian Well Machinery.

John Z. Thom, Patricroft. Manchester.

Belting.

Binney & Son, Catherine Street, City Road, London, E.C.
Fleming, Birkby & Goodall, Ltd., West Grove, Halifax.
Gilmour, W. & O., St. John's Hill, Edinburgh.

Boilers.

Clayton, Son & Co., Ltd., Leeds City Boiler Works, Leeds.
Grantham Crank & Iron Co., Ltd., Grantham.
Hartley & Sugden, Ltd., Halifax.

Boilers (Water-tube).

Babcock & Wilcox, Ltd., Oriel House, Farringdon Street, London, E.C.
Cochran & Co. (Annan), Ltd., Annan, Scotland.

Bolts, Nuts, Rivets, etc.

Herbert W. Periam, Ltd., Floodgate Street Works, Birmingham.
T. D. Robinson & Co., Ltd., Derby.

Books.

Crosby Lockwood & Son, Stationers' Hall Court, London, E.C.
Griffin, Charles, & Co., Exeter Street, Strand, W.C.
New Zealand Mines Record, Wellington, New Zealand.
Spon, E. & F. N. 125, Strand, W.C.

Cables.

St. Helen's Cable Co. Ltd. Warrington, Lancashire.

Case-Hardening Compounds.

Hy. Miller & Co., Millgarth Works, Leeds.

Catalogues, Printing, &c.

Atlantic Press, Ltd., Weymouth Street, Manchester.
Southwood, Smith & Co., Ltd., Plough Court, Fetter Lane, London, E.C.
Spottiswoode Advertising Agency, 8, New Street Square, E.C.
Stafford, Arthur, & Co., Denton, Manchester.

Chucks.

Fairbanks Co., 78-80, City Road, London, E.C.

Cisterns, Tanks, &c.

F. A. Keep, Juxon & Co. Barn Street, Birmingham.

Clutches (Friction).

David Bridge & Co., Castleton Ironworks, Rochdale, Lancashire.

Colliery Plants.

Graham, Morton & Co. Ltd. Leeds.

Condensing Plant.

Concentric Condenser, Ltd., 23, Northumberland Avenue, London, W.C.
Mirrlees-Watson & Co. Ltd., Glasgow.

Condensed Water Purifiers.

Lassen & Hjort, 52, Queen Victoria Street, London, E.C.

Consulting Engineers.

Gibbs, John, & Son, 80, Juke Street, Liverpool.
G. H. Hughes, A.M.I.M.E., 97, Queen Victoria Street, London, E.C.
Melville & Macalpine, 615 Walnut Street Philadelphia, Pa, U.S.A.

Continental Railway Arrangements.

South Eastern & Chatham Railway Co.

Conveying and Elevating Machinery.

Adolf Bleichert & Co., Leipzig-Gohlis, Germany.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Graham, Morton & Co., Ltd., Leeds.
Temperley Transporter Co., 72, Bishopsgate Street Within, London, E.C.

Coverings (Boiler).

Magnesia Coverings, Ltd., Washington Station, co. Durham.

Cranes, Travellers, Winches, etc.

Joseph Booth & Bros. Ltd, Rodley, Leeds.
Thomas Broadbent & Sons, Ltd., Huddersfield
Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W

Cranks.

Clarke's Crank & Forge Co. Ltd., Lincoln, England.

Cutters (Milling).

E. G. Wrigley & Co., Ltd., Foundry Lane Works, Soho, Birmingham.

Destructors.

Heenan & Froude, 4, Chapel Walks, Manchester.
Horsfall Destructor Co., Ltd., Armley, Leeds.

Dredges and Excavators.

Delange & Cie, Mce., Hoboken, near Antwerp.
Rose, Downs & Thompson, Ltd., Old Foundry, Hull.

Economisers.

E. Green & Son Ltd., Manchester.

Ejectors (Pneumatic).

Hughes & Lancaster, 47, Victoria Street, London, S.W.

Electrical Apparatus.

Allgemeine Elektricitäts Gesellschaft, Berlin, Germany.
Broadbent, T. W., Victoria Electrical Works, Huddersfield.
Crypto Electrical Co., 3, Tyer's Gateway, Bermondsey Street, London, S.E.
Gent & Co., Ltd., Faraday Works, Leicester.
Greenwood & Batley, Ltd., Albion Works, Leeds.
India Rubber, Gutta Percha, and Telegraph Works Co., Ltd., The Silvertown, London, E.
Mather & Platt, Ltd., Salford Iron Works, Manchester.
Matthews & Yates, Ltd., Swinton, Manchester.
Mix and Genest, Berlin, W., Germany.
Nalder Bros. & Thompson, 34, Queen Street, London, E.C.
Newton Brothers, Full Street, Derby.
Phœnix Dynamo Manufacturing Co., Bradford, Yorks.
Sturtevant Engineering Co., Ltd., 147, Queen Victoria Street, London, E.C.
Turner, Atherton & Co., Ltd., Denton, Manchester.
B. Weaver & Co., 22, Rosoman Street, Clerkenwell, London, E.C.

Engineers' Supplies.

Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.

Engines (Electric Lighting).

McLaren J. and H., Midland Engine Works Leeds.

Engines (Locomotive).

Baldwin Locomotive Works, Philadelphia, Pa., U.S.A.
Hunslet Engine Co., Ltd., Leeds, England.
Hudswell, Clarke & Co., Ltd., Leeds, England.

Engines (Portable).

Garrett R., & Sons, Leiston, R.S.O., Suffolk.

Engines (Stationary).

Allis-Chalmers Co., 533, Salisbury House Finsbury Circus, London, E.C.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Garrett, R. & Sons, Leiston, R.S.O., Suffolk.
Mirrlees Watson Co., Ltd., Glasgow.
Soest, L., & Co., Ltd., 114-116, Victoria Street, London, S.W.

Engines (Traction).

Jno. Fowler & Co. (Leeds), Ltd., Steam Plough Works, Leeds.
Garrett & Sons, Ltd., Richard, Leiston, R.S.O., Suffolk.

Engravers.

Jno. Swain & Son, Ltd., 58, Farringdon Street, London, E.C.

Exhaust Steam Oil Separators.

Lassen & Hjort, 52, Queen Victoria Street, London, E.C.

Fans, Blowers.

Capel Fan Co., 13, Moseley Street, Newcastle-on-Tyne.
Davidson & Co., Ltd., "Sirocco" Engineering Works, Belfast, Ireland.
Gibbs, John & Son, 80, Juke Street, Liverpool.
James Keith & Blackman Co., Ltd., 27, Farringdon Avenue, London, E.C.
Matthews & Yates, Ltd., Swinton, Manchester.

Fire Bricks.

J. H. Sankey & Son, Ltd., Essex Wharf, Canning Town, London, E.

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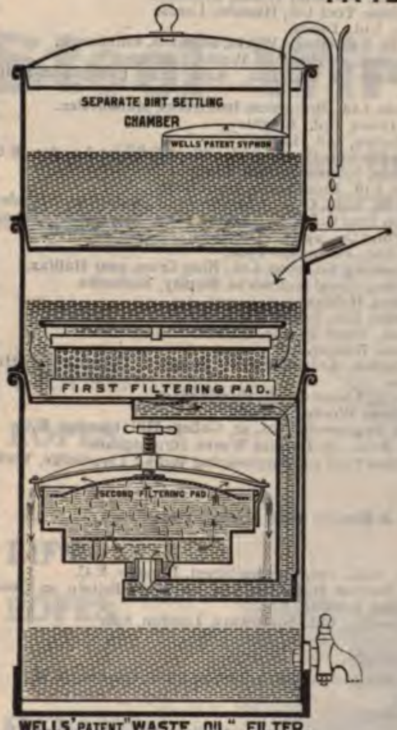

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SUPPLIED TO THE PRINCIPAL GOVERNMENTS FOR THE NAVY, DOCKYARDS, &c., AND TO THE LEADING ELECTRIC LIGHT INSTALLATIONS, ENGINEERING WORKS, GAS ENGINE MAKERS, PRINTERS, &c., &c.

OVER *10,000* SOLD.

MONEY SAVERS to any USERS OF MACHINERY.

Pay first cost in a short time, as Dirtied Oil, which has hitherto been thrown away, can be filtered and used again and again.

Write for List of Testimonials and Samples of Work done by the Filter.

No. 1.	For users having only a small quantity of oil to treat (no syphon) 17 in. by 9 in.	35/-
No. 2.	Two top chambers hold about 3 gallons oil, 22 in. by 10 in. ..	50/-
No. 3.	Two top chambers hold about 6 gallons oil, 27 in. by 12 in. ...	70/-
No. 4.	Two top chambers hold about 12 gallons oil, 36 in. by 16 in. ...	110/-
No. 5.	Two top chambers hold about 24 gallons oil, 43 in. by 23 in. ...	189/-
No. 6.	Very powerful Filter for treating large quantities of oil, 54 in. by 30 in.	336/-

Capable of dealing with **250** Galls. Oil per week

LARGER SIZES MADE TO ORDER.

NO OUTSIDE POWER REQUIRED.

LIME, WHITING, OR COLD WATER PAINTS,

Applied at a speed of from 8 to 10 square yards per minute, in a manner superior to brush work.

One coat with the Machine on rough surfaces is equal to two applied with brushes.

Will save First Cost in a Few Days.

No. 6.	Handy Size. No Tank. On Wheels.	£7 7s.
No. 4.	Price, with 5 ft. Pole, Single Spraying Nozzle, and 20 ft. Special Armoured Hose. Capacity 6 gals.	£8 10s.
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No. 5.	With 5-ft. Pole, Double Spraying Nozzle, and 20 ft. Special Armoured Hose, Large Size. Capacity 10 gals.	£10 10s.
No. 5A.	Ditto Ditto fitted with Wheels.	£11 15s.

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MUCH SUPERIOR TO ORDINARY LIMEWASH. SLAKED WITH WATER. QUICKLY MIXED. WILL NOT RUB OFF. LEAVES A GOOD SURFACE.

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No. 4a, with Wheels.

A. C. WELLS & Co.,
100a, Midland Road, St. Pancras,
Works: Cheetham, Manchester. LONDON, N.W.

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Firewood Machinery.
M. Glover & Co., Patentees and Saw Mill Engineers, Leeds.

Fountain Pens.
Mabie, Todd & Bard, 93, Cheapside, London, E.C.

Forging (Drop) Plants.
Brett's Patent Lifter Co., Ltd., Coventry.

Forgings (Drop).
J. H. Williams & Co., Brooklyn, New York, U.S.A.

Furnaces.
Deighton's Patent Flue & Tube Company, Vulcan Works, Pepper Road, Leeds.
Leeds Forge Co., Ltd., Leeds.
W. F. Mason, Ltd., Engineers, Manchester.

Gas Producers.
Graham, Morton & Co., Ltd., Leeds.
W. F. Mason, Ltd., Engineers, Manchester.
Power-Gas Corporation, Ltd., 39, Victoria Street, London, S.W.

Gauge Glasses.
J. B. Treasure & Co., Vauxhall Road, Liverpool.

Gearing.
Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.
Hamilton & Co., J. B., 145, Cannon Street, E.C
Reid Gear Co., Linwood, near Glasgow.
Wild, M. B., & Co., Corporation Street, Birmingham.

Gold Dredging Plant.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.

Greases.
Blumann and Stern, Ltd., Plough Bridge, Deptford, London S.E.

Hack Saws.
Baynes, Charles, Knuzden Brook, Blackburn.

Hammers (Steam).
Davis & Primrose, Leith Ironworks, Edinburgh.
Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

Hoisting Machinery.
See Conveying Machinery.

Horizontal Boring Machines.
Greenwood & Batley, Albion Works, Leeds.
Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

Hydraulic Leather.
Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.

Icemaking and Refrigerating Machinery.
H. J. West & Co., 114-118, Southwark Bridge Road, London, S.E.

Indicators.
Dobbie McInnes, Ltd., 41 & 42, Clyde Place, Glasgow.
Hannan & Buchanan, 75, Robertson Street, Glasgow.

Iron and Steel.
Askham Bros. & Wilson, Ltd., Sheffield.
Consett Iron Co., Ltd., Consett, Durham, and Newcastle-on-Tyne.
Fairley & Sons, James, Old Mint, Shadwell Street, Birmingham.
Farnley Iron Co., Ltd., Leeds England.
Fried. Krupp, Grusonwerk, Magdeburg-Buckau, Germany.
Hadfield's Steel Foundry Co., Ltd., Sheffield.
J. Frederick Melling, 14, Park Row, Leeds, England.
Parker Foundry Co., Derby.
Purden, John & Sons, Lambhill Forge, by Maryhill, Glasgow.
Walter Scott, Ltd., Leeds Steel Works, Leeds, England.
Gilbert Thompson & Co., 116, Victoria Street, London, S.W.

Ironwork (Constructional).
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Ironwork (Galvanised).
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Lagging Sheets.
Zeitz & Co., 21, Lime Street, London, E.C.

Lathes.
Bradbury & Co., Ltd., Wellington Works, Oldham.
Eclipse Tool Manufacturing Co., Linwood, near Glasgow.
Leckenby, Benton, & Co., Perseverance Ironworks, Halifax.
Mitchell, D., & Co., Ltd., Central Ironworks, Lawkholme, Keighley.
Northern Engineering Co. (1900) Ltd., King Cross, near Halifax.

Lathe Carriers.
Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Laundry Machinery.
W. Summerscales & Sons, Ltd., Engineers, Phœnix Foundry Keighley, England.

Lifts.
Waygood & Co., Ltd., Falmouth Road, London, S.E.

Lubricants.
Blumann & Stern, Ltd., Plough Bridge, Deptford, London, S.E.
Reliance Lubricating Oil Co., The, 19 & 20, Water Lane, Great Tower Street, London, E.C.
Matthew Wells & Co., Hardman Street Oil Works, Manchester.

Machine Tools.
George Addy & Co., Waverley Works, Sheffield.
Bateman's Machine Tool Co., Hunslet, Leeds.
Hy. Berry & Co., Ltd., Leeds.
Bertrams, Ltd., St. Katherine's Works, Sciennes, Edinburgh.
Bradbury & Co., Ltd., Wellington Works, Oldham.
Breuer, Schumacher & Co., Ltd., Kalk, near Cologne-on-Rhine (Germany).
Cunliffe & Croom, Ltd., Broughton Ironworks, Manchester.
Dean, Smith & Grace, Ltd., Keighley.
Greenwood & Batley, Ltd., Leeds.
Jones & Lamson Machine Co., 97, Queen Victoria Street, London, E.C.
John Lang & Sons, Johnstone, near Glasgow.
Luke & Spencer, Ltd., Broadheath, Manchester.
Mitchell, D., & Co., Ltd., Central Ironworks, Lawkholme, Keighley.
Jos. C. Nicholson Tool Co., City Rd. Tool Wks., Newcastle-on-Tyne.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne.
Northern Engineering Co., 1900, Ltd., King Cross, near Halifax.
J. Parkinson & Son, Canal Ironworks, Shipley, Yorkshire.
C. Redman & Sons, Halifax.
Rice & Co. (Leeds), Ltd., Leeds, England.
G. F. Smith, Ltd., South Parade, Halifax.
John Stirk & Sons, Halifax.
Taylor and Challen, Ltd., Derwent Foundry, Constitution Hill, Birmingham.
H. W. Ward & Co., Lionel Street, Birmingham.
T. W. Ward, Albion Works, Sheffield.
West Hydraulic Engineering Co., 23, College Hill, London, E.C.
Winn, Charles. & Co., St. Thomas Works, Birmingham.
Yorkshire Machine Tool and Engineering Works, Liversedge, Yorks.

Marks.
Pryor, Edward, & Son, 68, West Street, Sheffield.

Metals.
Delta Metal Co., Ltd., 110, Cannon Street, London, E.C.
Magnolia Anti-Friction Metal Co., Ltd., of Great Britain, 49, Queen Victoria Street, London, E.C.
Phosphor Bronze Co., Ltd., Southwark, London, S.E.

Metals (Perforated).
W. Barns & Son, Chalton Street, Euston Road, London, N.W.

Mining Machinery.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.

Office Appliances.
Halden & Co., J., 8, Albert Square, Manchester.
Hall & Co., B. J., 39, Victoria Street, London, S.W.
Lyle Co., Ltd., Harrison Street, Gray's Inn Road, London, W.C.
Rockwell-Wabash Co., Ltd., 69, Milton Street, London, E.C.
Shannon, Ltd., Ropemaker Street, London, E.C.
Titan Binder Co., 31, Queen Victoria Street, London, E.C.
Trading and Manufacturing Co., Ltd., Temple Bar House, Fleet Street, London, E.C.

Oils, &c.
Blumann and Stern, Ltd., Plough Bridge, Deptford, London, S.E.
Wells, M., & Co., Hardman Street Oil Works, Manchester.

Packing.
Beldam Packing & Rubber Co., 93-94, Gracechurch Street, London, E.C.
Frictionless Engine Packing Co., Ltd., Hendham Vale Works, Harpurhey, Manchester.
Lancaster & Tonge, Ltd., Pendleton, Manchester.
Redfern & Co., S., Swan Lane, New Brown Street, Manchester.
Quaker City Rubber Co., Coronation House, Lloyd's Avenue, E.C.
United Kingdom Self-Adjusting Anti-Friction Metallic Packing Syndicate, 14, Cook Street, Liverpool.
United States Metallic Packing Co., Ltd., Bradford,
J. Bennett von der Heyde, 6, Brown Street, Manchester.

Paint (Metallic).
Metallic Paint Co., Ltd., Cardiff.

Paper.
Lepard & Smiths, Ltd., 29, King Street, Covent Garden, London, W.C

Patent Agents.
Page & Rowlingson, 28, New Bridge Street, London, E.C.

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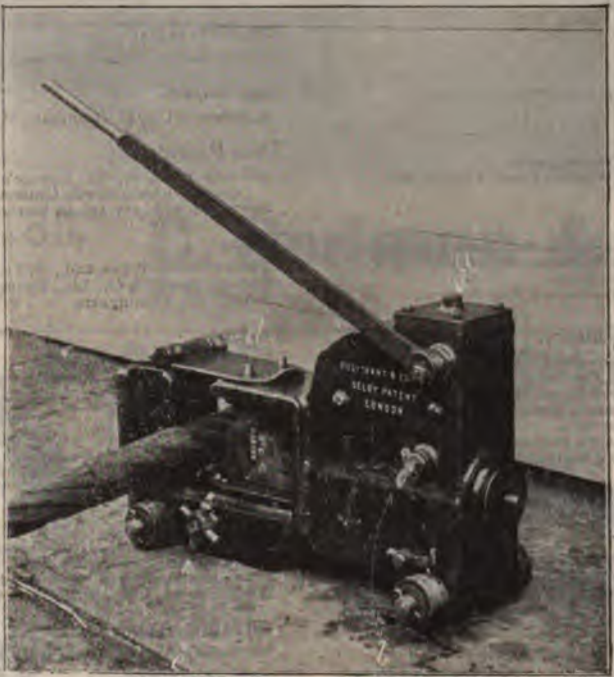

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Patent Hydraulic Rope-Cutting Machine (SELBY PATENT)

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J. Halden & Co., 8, Albert Square, Manchester.
B. J. Hall & Co., 39, Victoria Street, London, S.W.

Photographers.

Booker & Sullivan, 67 and 69, Chancery London, W.C.
Elliott & Fry, 55, Baker Street, London, W.

Photographic Apparatus.

Marion & Co., Ltd., 22, 23, Soho Square, London, W.

Pinch Bars.

Samson & Co., Garforth, near Leeds.
Stone & Co., J. B., 135, Finsbury Pavement, London, E.C.

Pipe Wrenches (Chain).

Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Pistons.

Lancaster & Tonge, Ltd., Pendleton, Manchester.

Planished Sheets.

Zeitz & Co., 21, Lime Street, London, E.C.

Porcelain.

Gustav Richter, Charlottenburg, near Berlin, Germany.

Presses (Hydraulic).

Greenwood & Batley, Albion Works, Leeds.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

Publishers.

Crosby Lockwood & Son, 7, Stationers' Hall Court, London, E.C.
Charles Griffin & Co., Ltd., Exeter Street, Strand, London, W.C.
Spon, E. and F. N., 125, Strand, W.C.
New Zealand Mines Record, Wellington, New Zealand.

Pumps and Pumping Machinery.

Drum Engineering Co., 27, Charles Street, Bradford.
Enke, Carl, Schkeuditz-Leipzig, Germany.
Fairbanks, Morse & Co., 126, Southwark Street, London, S.E.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
J. P. Hall & Sons, Ltd., Peterborough.
Hathorn, Davey & Co., Ltd., Leeds, England.
Positive Rotary Pumps, Ltd., 23, Northumberland Avenue, London, W.C.
Tangyes, Ltd., Cornwall Works, Birmingham.

Radial Drilling Machines.

Greenwood & Batley, Albion Works, Leeds.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Northern Engineering Co. (1900), Ltd., King Cross, near Halifax.

Rails.

Wm. Firth, Ltd., Leeds.

Railway Wagons.

Nye, A. W., 110, Cannon Street, London, E.C.
W. R. Renshaw & Co., Ltd., Phœnix Works, Stoke-on-Trent.

Riveted Work

F. A. Keep, Juxon & Co., Forward Works, Barn Street, Birmingham.

Roofs.

D. Anderson & Son, Ltd., Lagan Felt Works Belfast.
Graham, Morton & Co., Ltd., Leeds.
Head, Wrightson & Co., Ltd., Thornaby-on-Tees.

Ropeways (Aerial).

Bullivant & Co., Ltd., 72, Mark Lane, London, E.C.

Scientific Instruments.

Cambridge Scientific Instrument Co., Ltd. Cambridge.

Spanners.

Williams, J. H. & Co., Brooklyn, New York, U.S.A.

Stampings.

Thomas Smith & Sons of Saltley, Ltd., Birmingham.
Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Stamps (Rubber).

Rubber Stamp Co., 1 & 2, Holborn Buildings, Broad Street Corner Birmingham.

Stamps (Metal).

Edward Pryor & Son, 68, West Street, Sheffield.

Steam Traps.

British Steam Specialties, Ltd., Fleet Street, Leicester.
Lancaster & Tonge, Ltd., Pendleton, Manchester.

Steam Wagons.

Thornycroft & Co., Ltd., J. I., Chiswick, London, W.
Yorkshire Patent Steam Wagon Co., Pepper Road, Hunslet, Leeds.

Steel Tools.

Saml. Buckley, St. Paul's Square, Birmingham.
Pratt & Whitney Co., 23-25, Victoria Street, London, S.W.

Stokers.

Ed. Bennis & Co., Ltd., Bolton, Lancs.
Meldrum Brothers, Ltd., Atlantic Works, Manchester.

Stone Breakers.

S. Pegg & Son, Alexander Street, Leicester.

Superheaters.

A. Bolton & Co., 40, Deansgate, Manchester.

Time Recorders.

Howard Bros., 10, St. George's Crescent, Liverpool, and 100, Queen Victoria Street, London, E.C.
Recorders, Ltd., 171, Queen Victoria Street, London, E.C.

Tubes.

Premier Boiler Tubes, Ltd., 28, Victoria Street, London, S.W.
Thomas Piggott & Co., Ltd., Spring Hill, Birmingham.
Tubes, Ltd., Birmingham.

Turbines.

G. Gilkes & Co., Ltd., Kendal.
Greenwood & Batley, Albion Works, Leeds.
S. Howes, 64, Mark Lane, London, E.C.

Typewriters.

Elliott-Fisher Co., 85, Gracechurch Street, London, E.C.
Empire Typewriter Co., 77, Queen Victoria Street, London, E.C.
Yost Typewriter Co., 50, Holborn Viaduct, London, E.C.

Valves.

Holmes & Co., W. C., Huddersfield.
Scotch and Irish Oxygen Co., Ltd., Rosehill Works, Glasgow.
Shaw, Joseph, Albert Works, Huddersfield.
Winn, Charles, & Co., St. Thomas Works, Birmingham.

Ventilating Appliances.

Matthews & Yates, Ltd., Swinton, Manchester.

Wagons—Steam.

Thornycroft & Co., J. I., Ltd., Chiswick, London, W.

Water Softeners.

Lassen & Hjort, 52, Queen Victoria Street London, E.C.

Weighing Apparatus.

W. T. Avery & Co., Soho Foundry, Birmingham, England.
Samuel Denison & Son, Hunslet Moor, near Leeds.
Graham, Morton & Co., Ltd., Leeds.

Wells Light.

A. C. Wells & Co., 100A Midland Road, St. Pancras, London, N.W.

Wind and Water Supply Machinery.

Eric S. A. Smith, Bridlington.

Wire Working Machinery.

Ed. Brand, 35, Shakespeare Street, Manchester.

"Woodite."

"Woodite" Company, Mitcham, Surrey.

PAGE'S WEEKLY Machine Tools, &c.

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Lathes, Planers, and Shapers

ARE OUR SPECIALITIES.

High-Grade Machines Only in Stock for Immediate Delivery.

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HALIFAX.

MACHINE TOOLS,

Special & General

For Engineers, Shipbuilders, Boiler Makers, Girder Makers, and Bridge Builders.

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LIMITED,
South Parade,
HALIFAX.
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HIGH SPEED LATHES

Our Speciality up to 12-in. Centre.

Price List on application.

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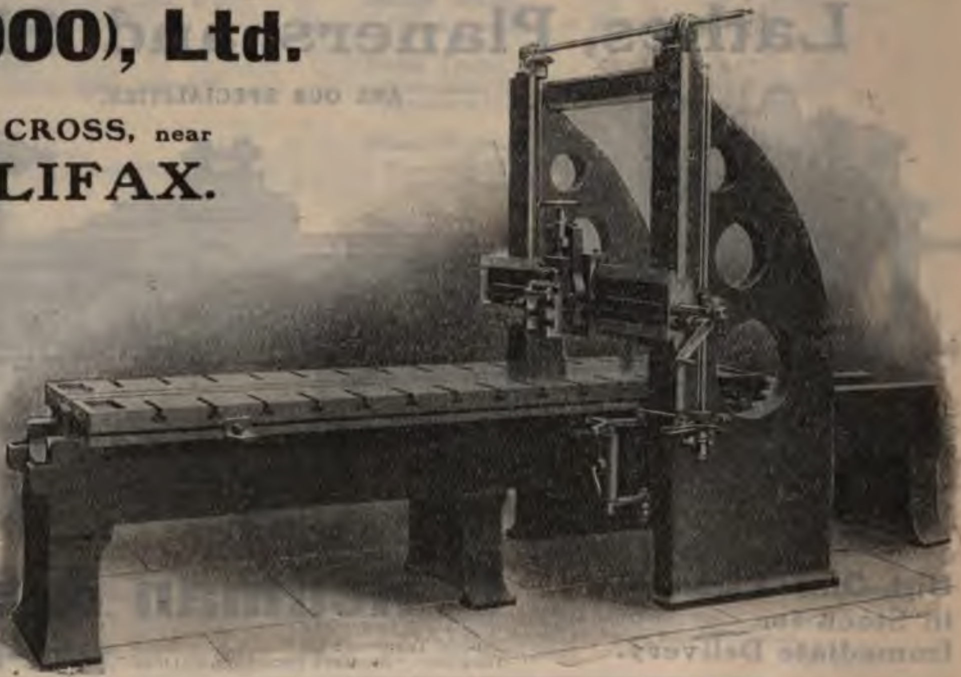

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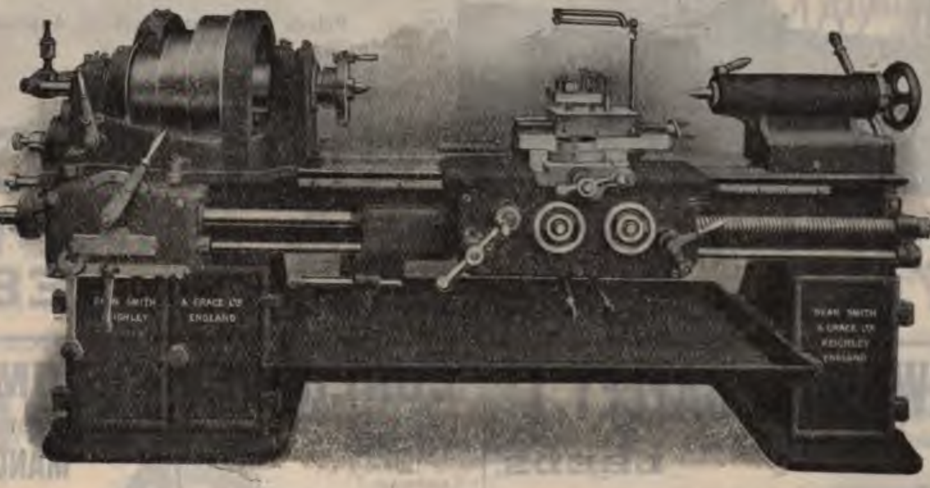
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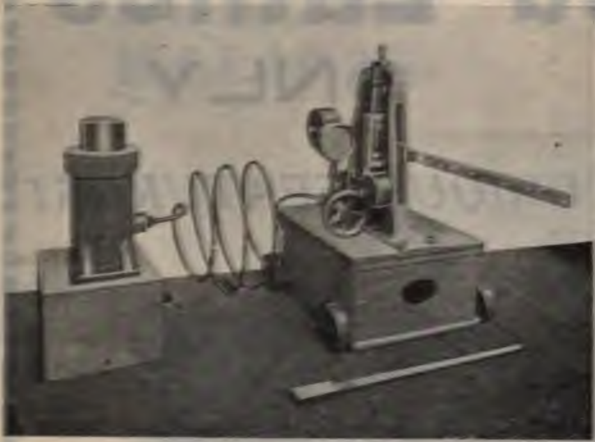

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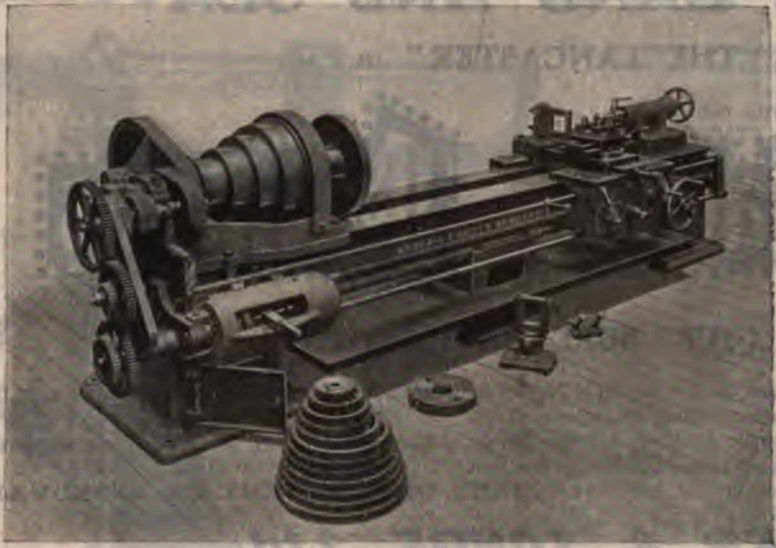

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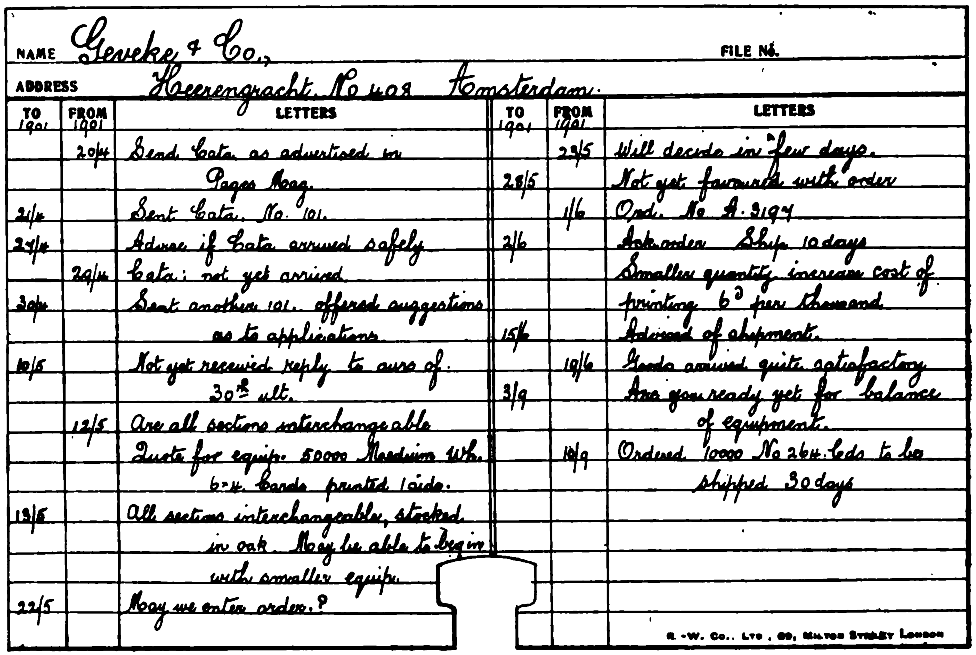

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		Pages Mag.	28/5		Not yet favoured with order
21/4		Sent Cata. No. 101.		1/6	Ord. No A.3197
27/4		Advise if Cata. arrived safely	2/6		Ack. order Ship 10 days
	29/4	Cata: not yet arrived			Smaller quantity increase cost of
30/4		Sent another 101. offered suggestions			printing 6^{d} per thousand
		as to applications	15/6		Advised of shipment.
10/5		Not yet received reply to ours of.		19/6	Goods arrived quite satisfactory
		30th ult.	3/9		Are you ready yet for balance
	12/5	Are all sections interchangeable			of equipment.
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		6×4. Cards printed 1 side.			shipped 30 days
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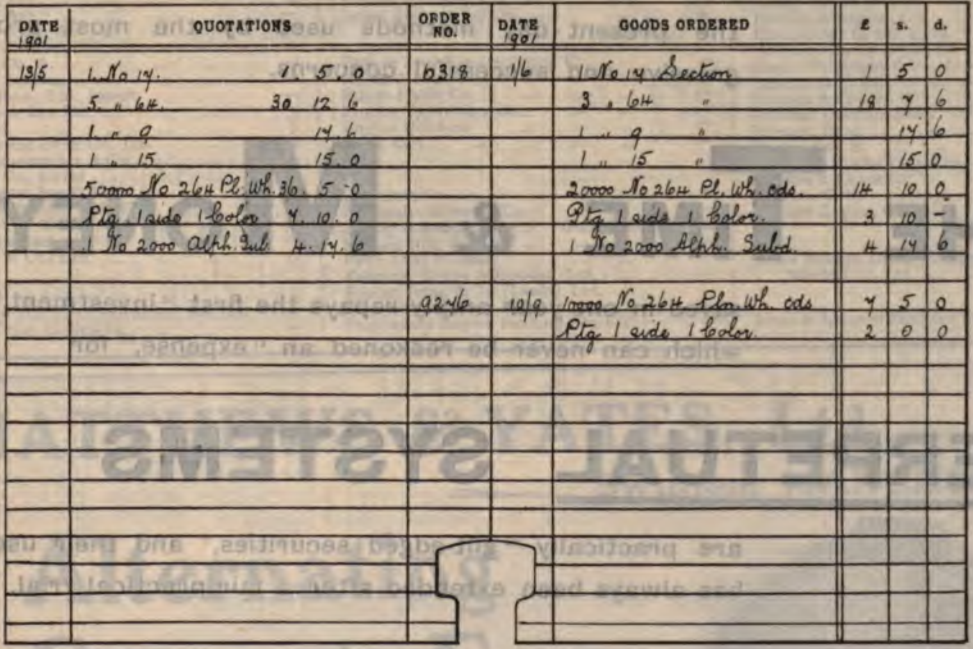

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	5. " 64. 30 12 6			3 " 64 "	18	7	6
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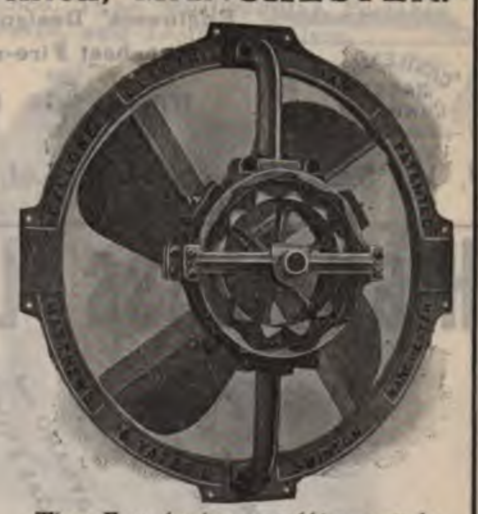

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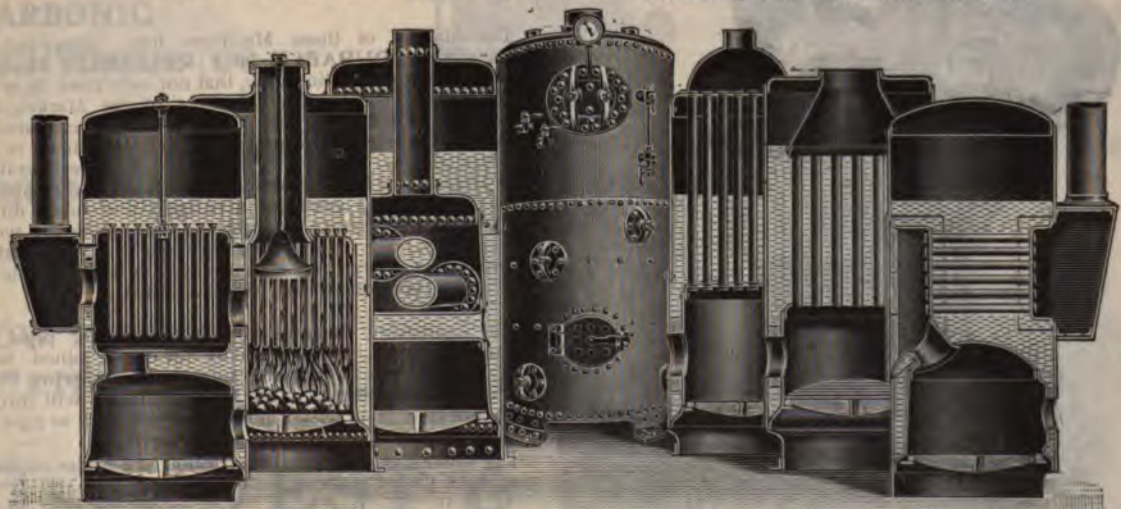

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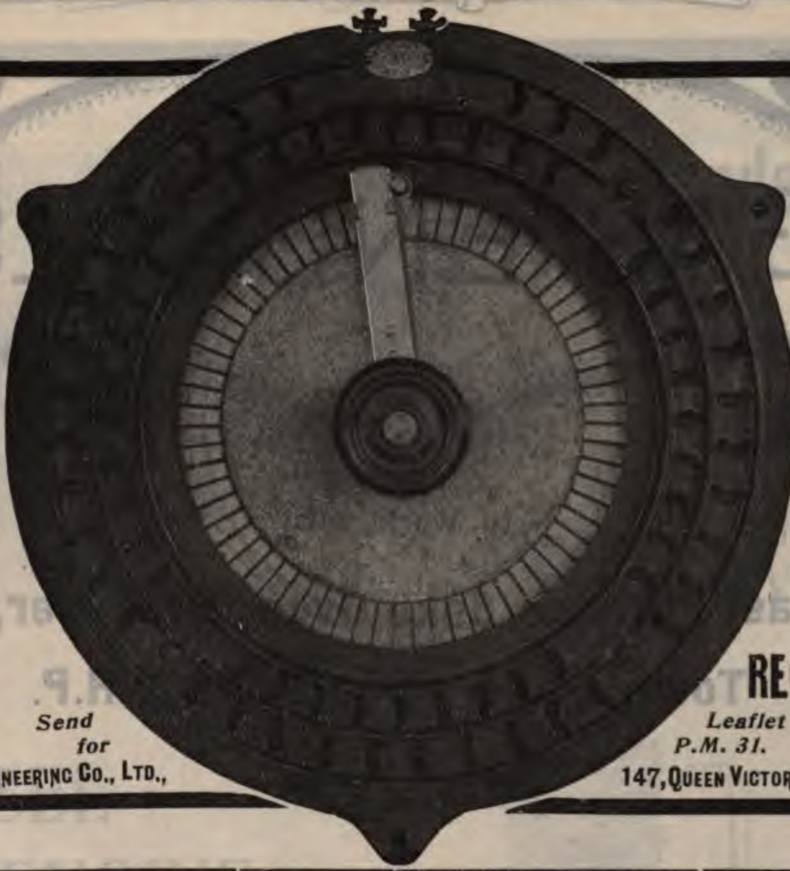

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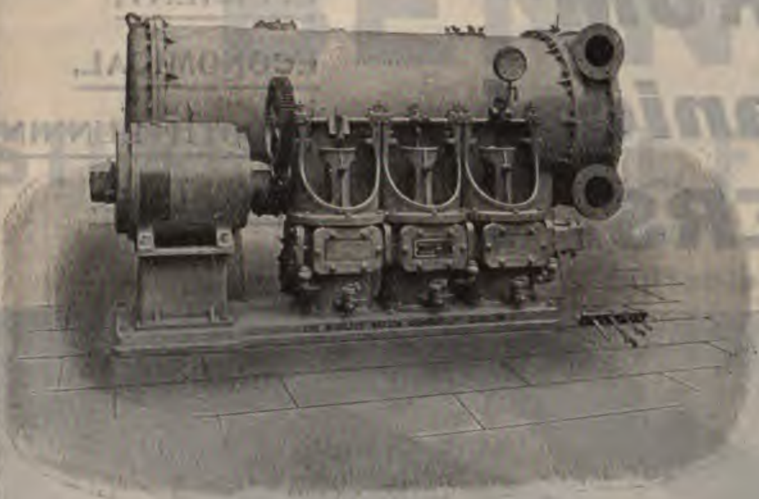

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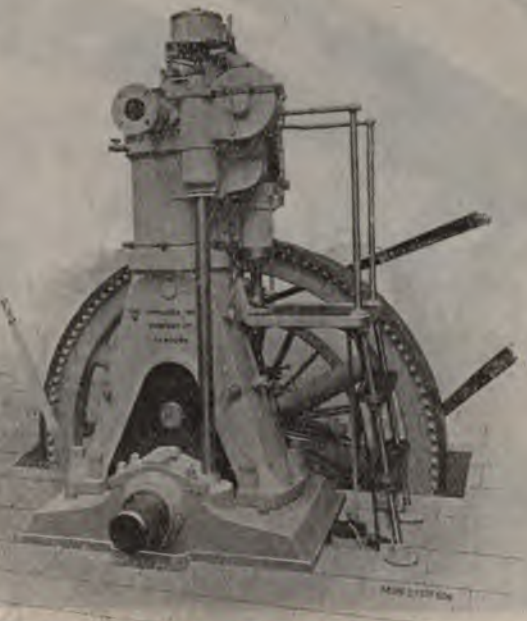

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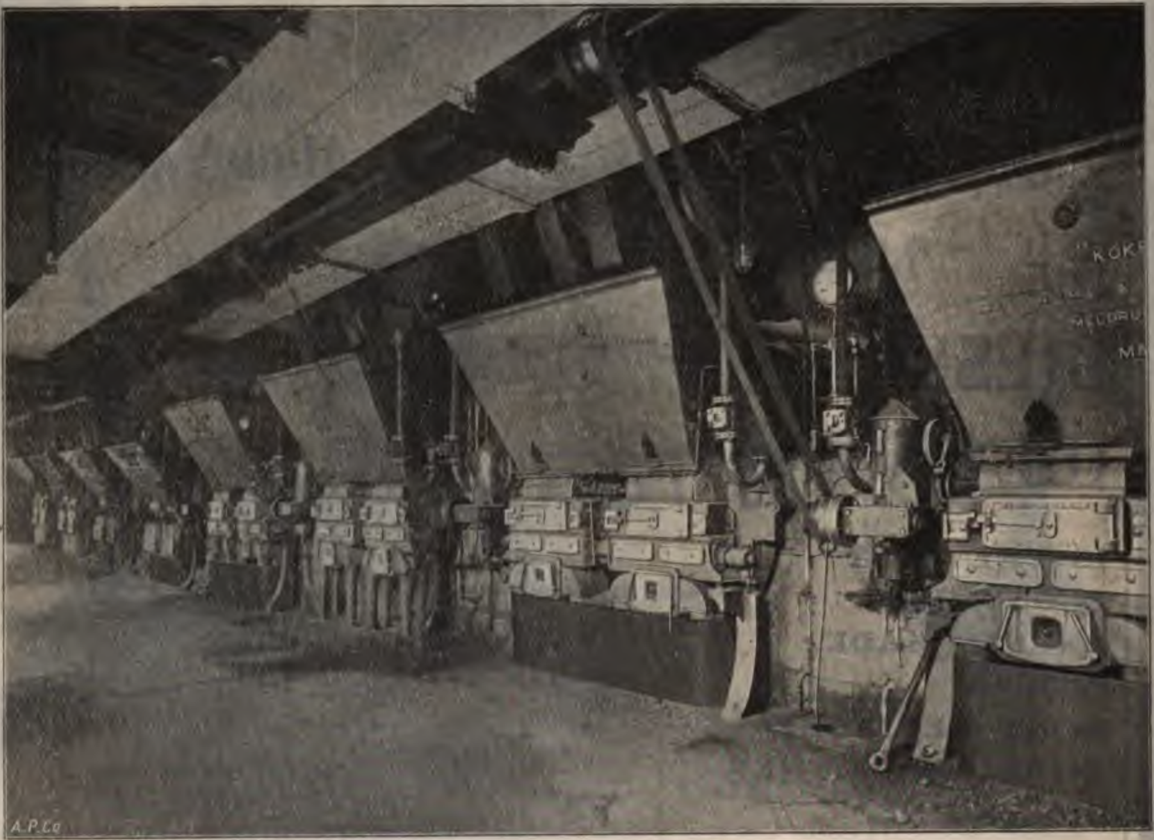

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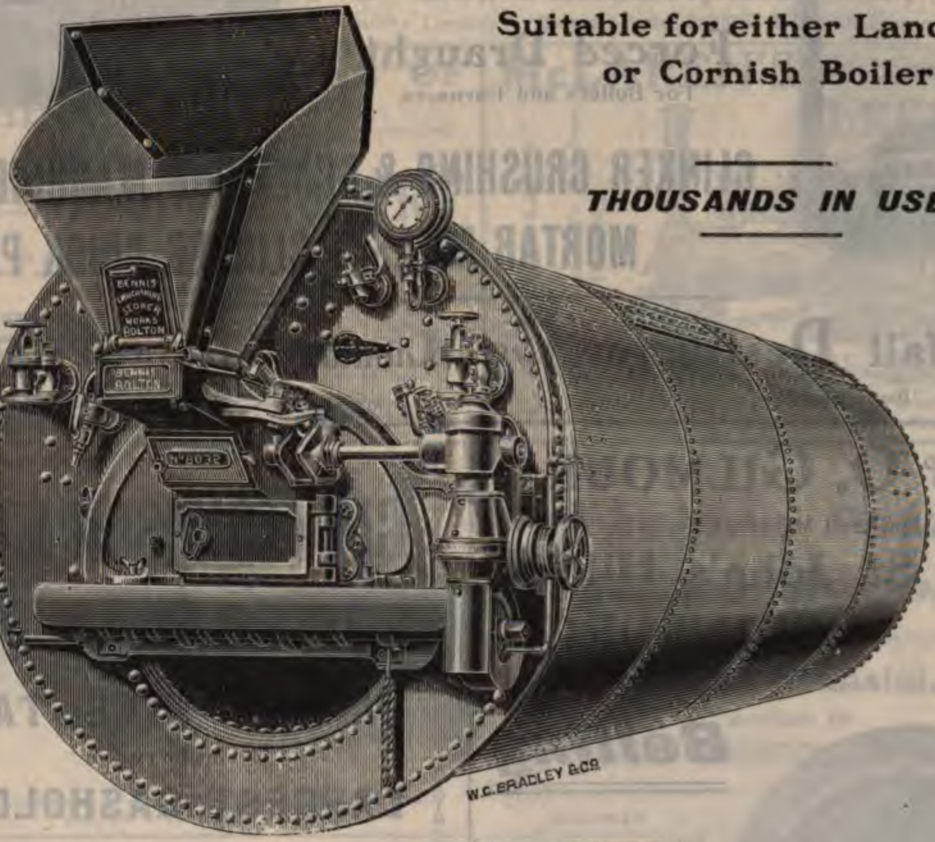

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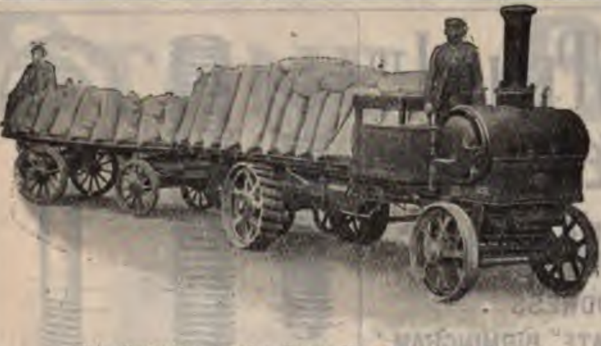

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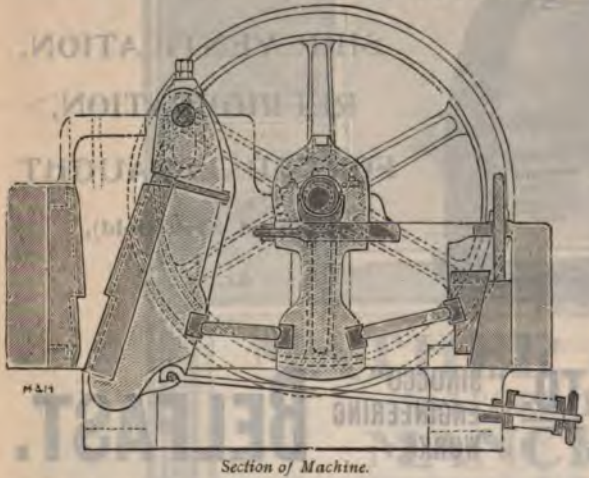

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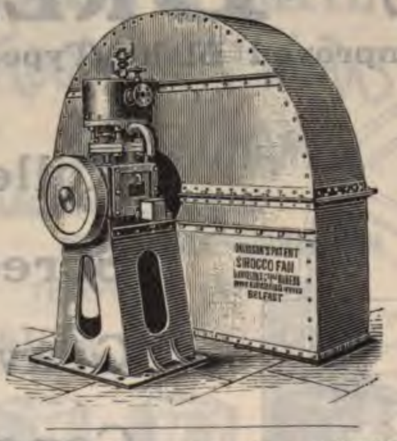

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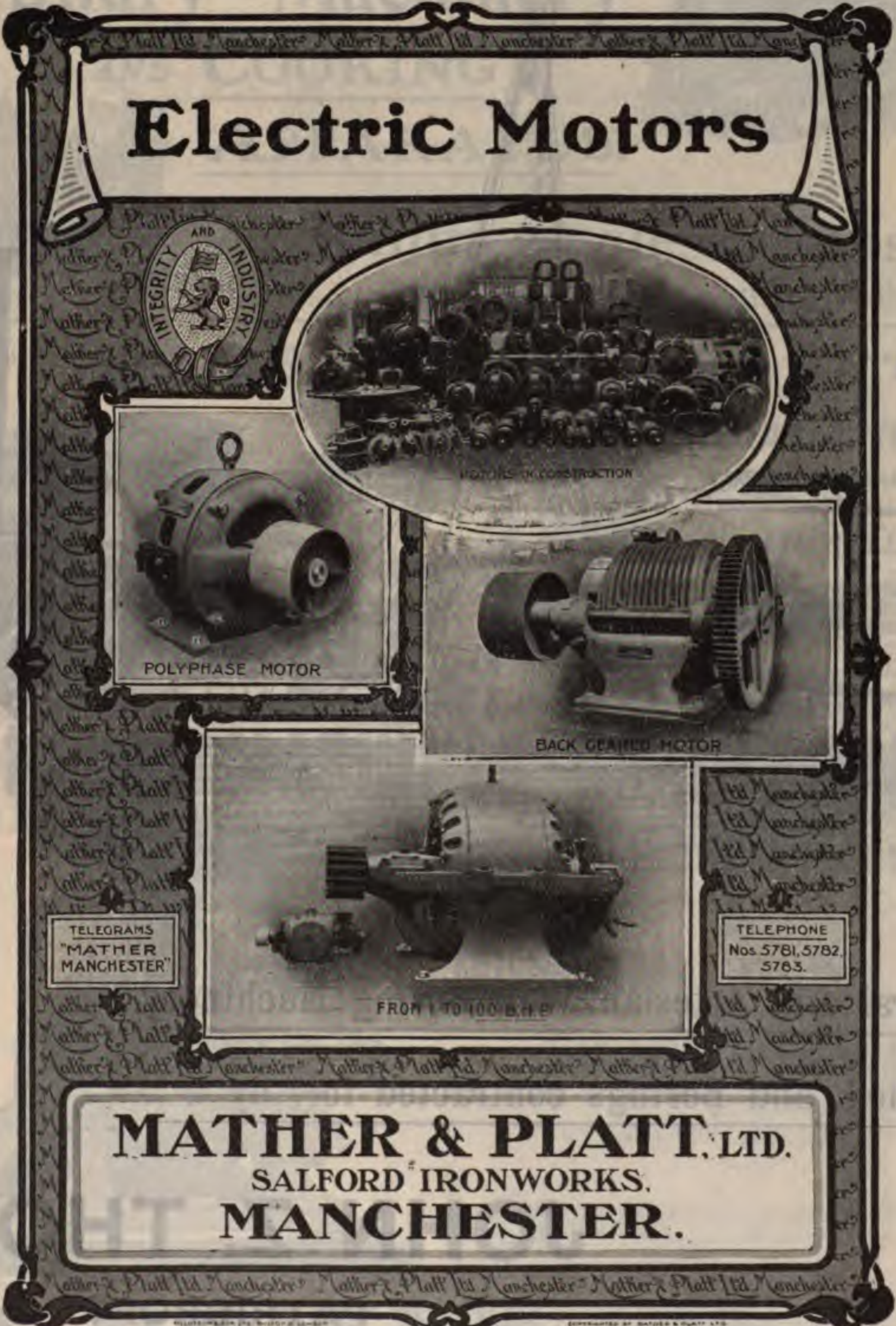

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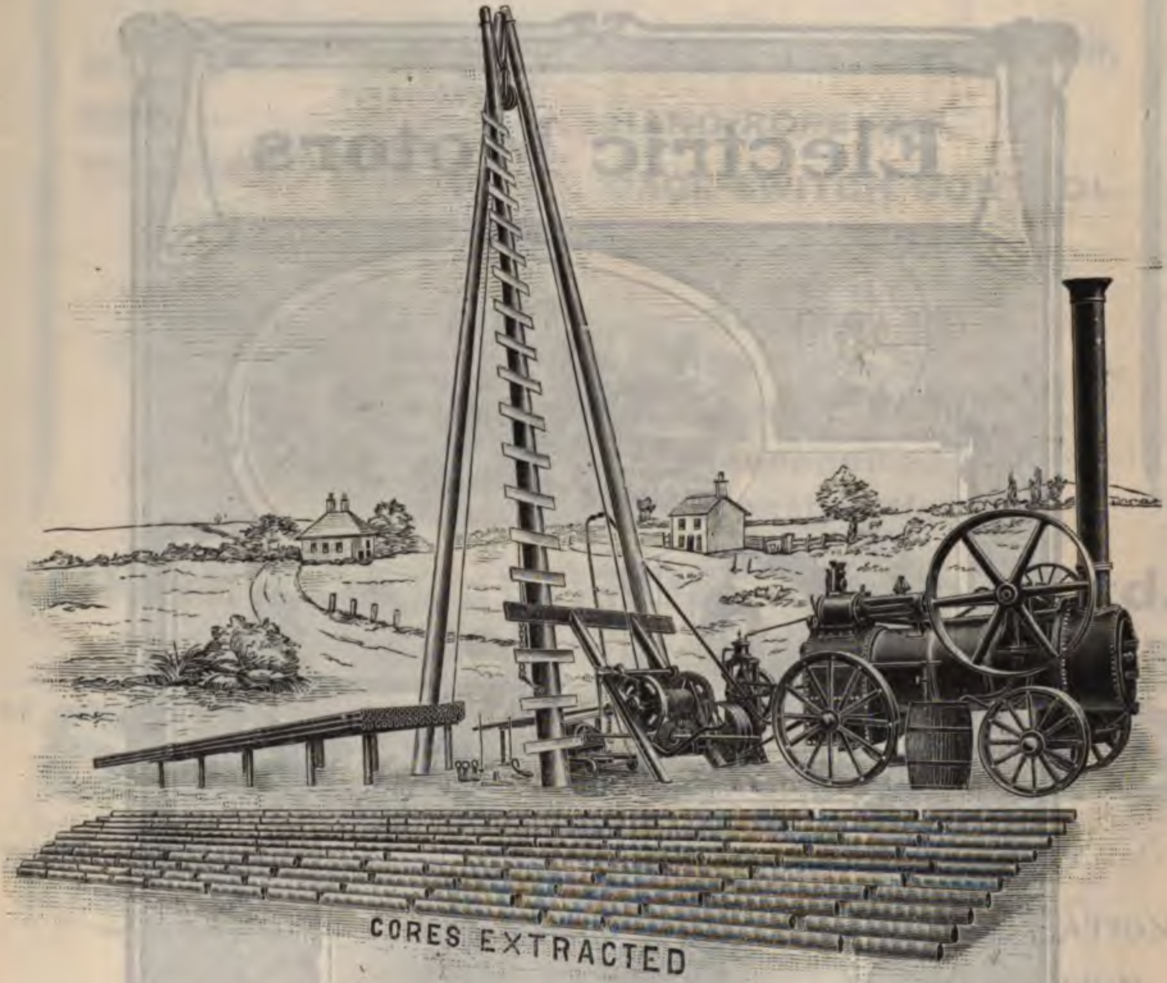

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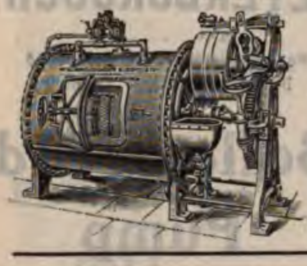

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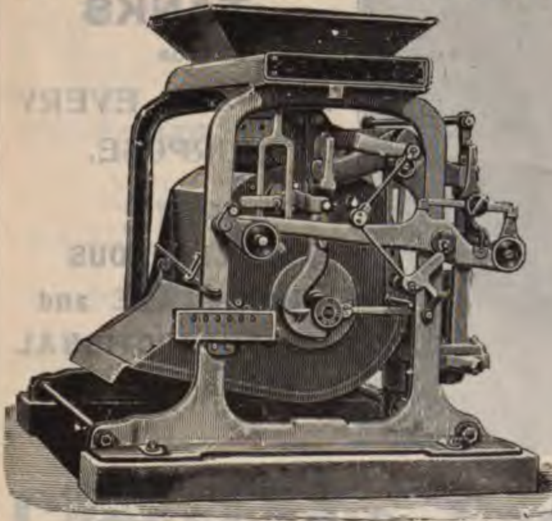

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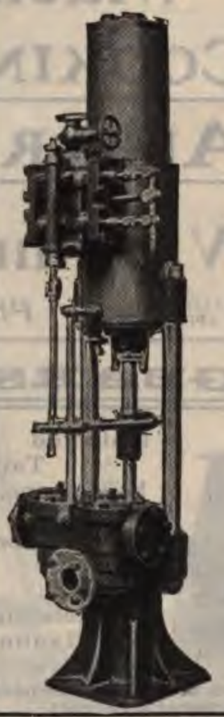

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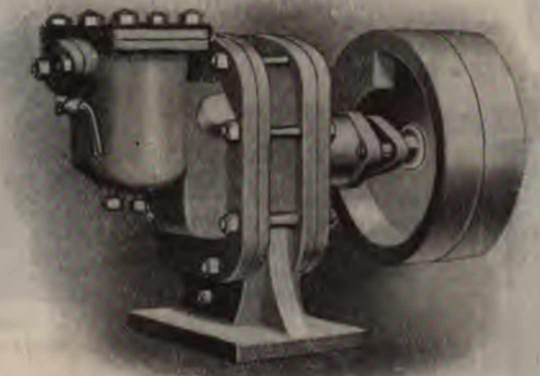

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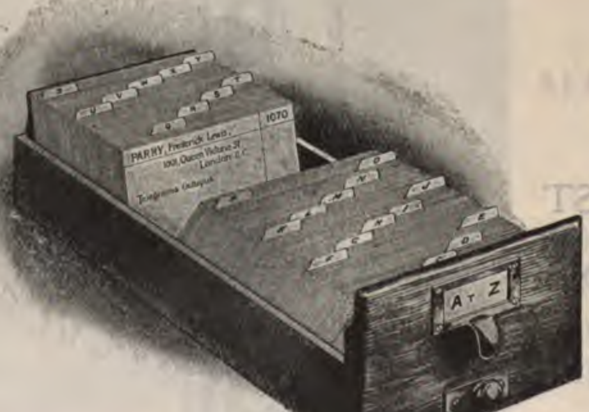

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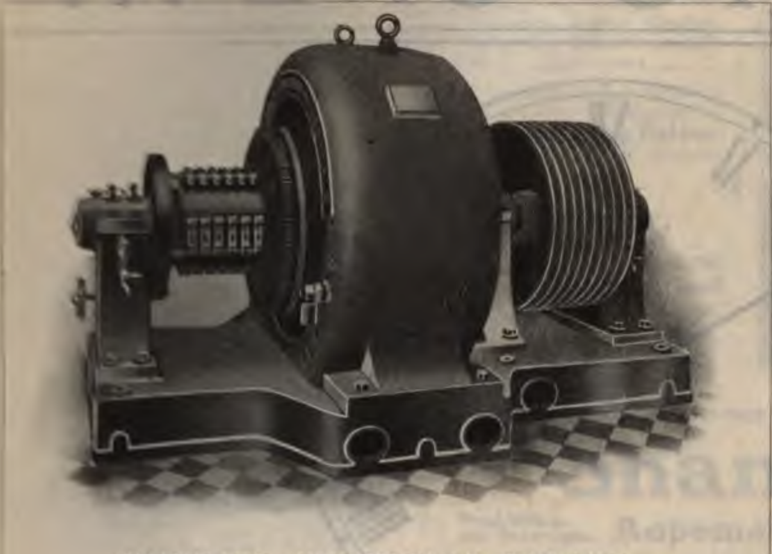

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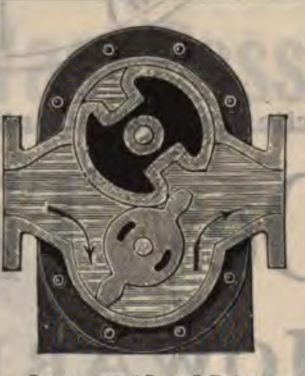

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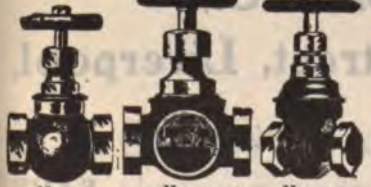
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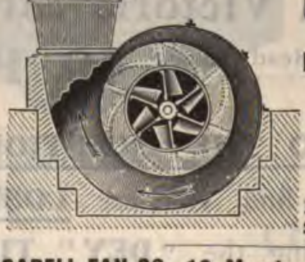

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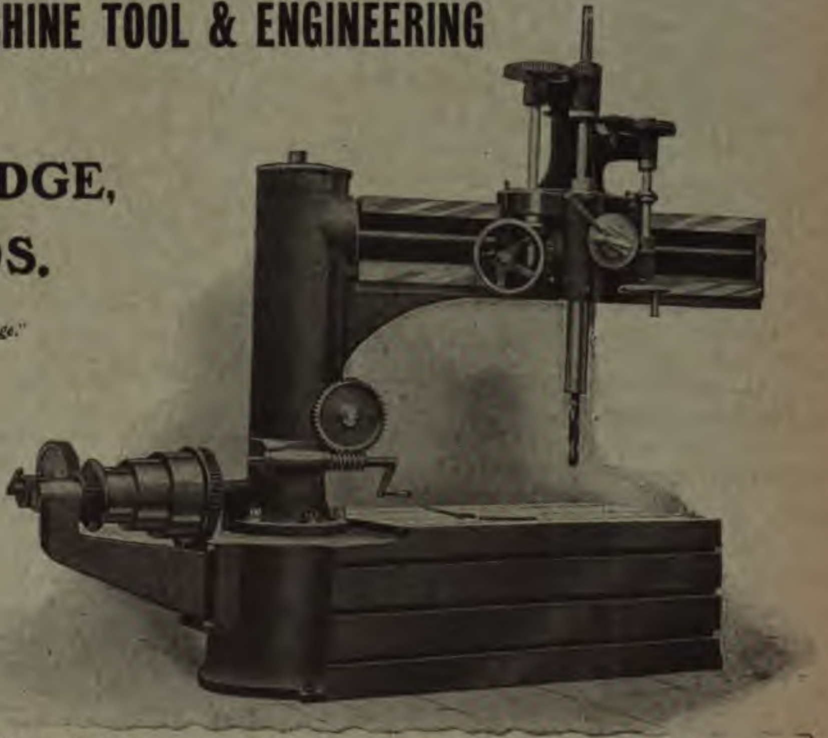

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